Aviation Week & Space Technology

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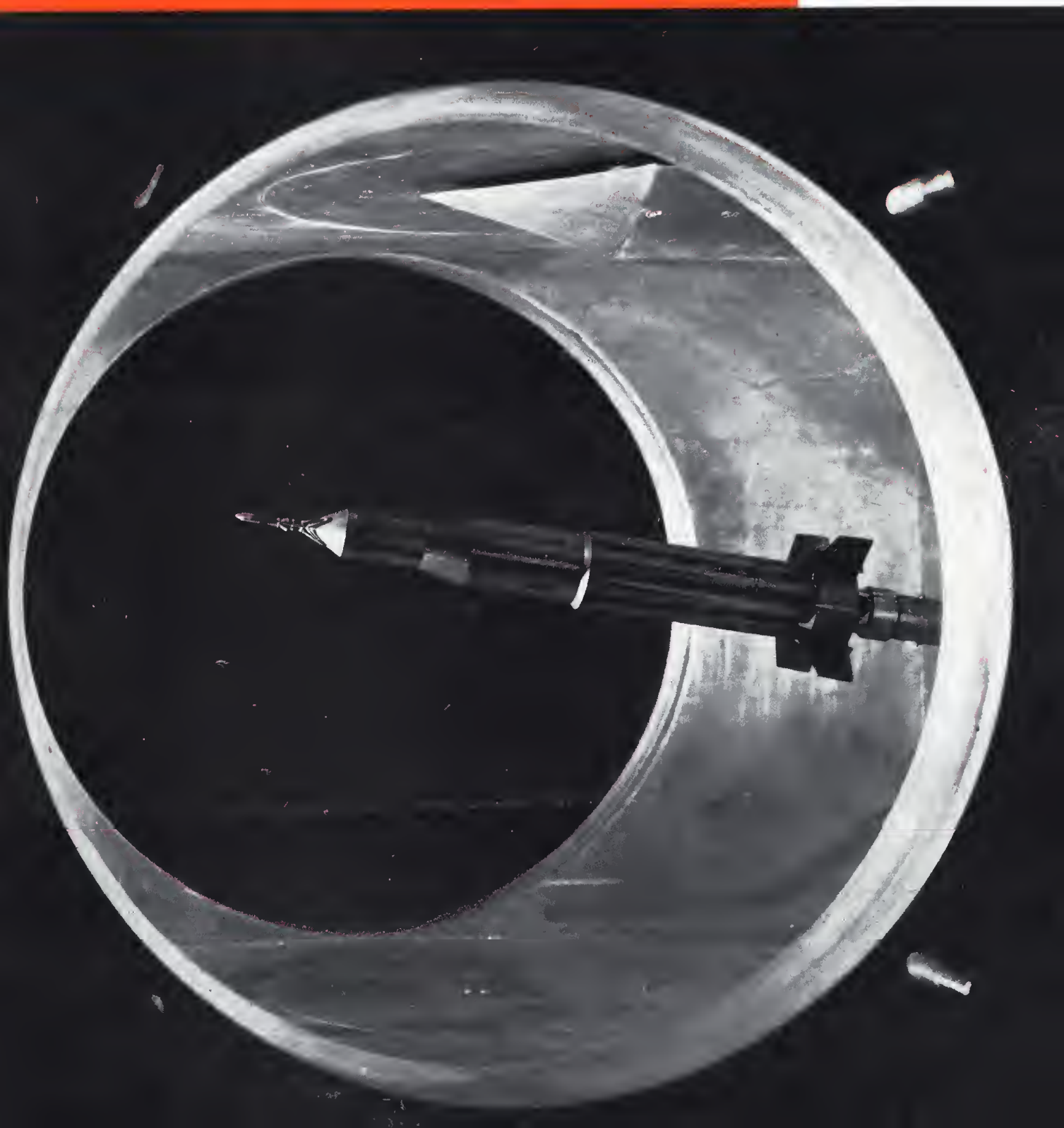
April 2, 1962

Apollo Reshapes NASA-Industry Relationships

Early Apollo/Saturn Model Test at Langley



AEROSPACE CALENDAR

Apr. 9-12—33rd Annual Scientific Meeting Aerospace Medical Assn. Chalfonte Haddon Hall, Atlantic City, N. J.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston. Sponsor: AF Cambridge Research Laboratories

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 11-13—Annual Technical Meeting and Equipment Exposition, Institute of Environmental Sciences, Sheraton Chicago Hotel, Chicago, Ill.

Apr. 12-13—Eighth Annual Heat Transfer Conference, Oklahoma State University, Stillwater, Okla.

Apr. 13—Government Contracts Symposium, National Assn. of Professional Contracts Administrators, Ambassador Hotel, Los Angeles, Calif.

Apr. 14—American Society for Metals 14th Annual Purdue Symposium, Purdue University, West Lafayette, Ind.

Apr. 16-18—Second Conference on Kinetics, Equilibria and Performance of High Temperature Systems, University of California, Los Angeles, Calif. Sponsor: Western States Section/Combustion Institute.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium, Institute of the Aerospace Sciences, Salt Lake City, Utah.

(Continued on page 7)

AVIATION WEEK and Space Technology

April 2, 1962

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AEROSPACE CALENDAR

(Continued from page 5)

Apr 19—Eastern Regional Meeting, Institute of Navigation, Shoreham Hotel, Washington, D C

Apr. 24-26—Polytechnic Institute of Brooklyn's Symposium on the Mathematical Theory of Automata, United Engineering Center, New York, N Y

Apr. 25-29—Western Space Age Industries and Engineering Exposition, Cow Palace San Francisco, Calif

Apr. 26-27—Quarterly Regional Meeting, Assn of Local Transport Airlines, Hilton Inn, Atlanta Ga

Apr 29-May 8—Hanover Air Show, Hanover, Germany

Apr 30-May 1—Annual Meeting National Aeronautical Services Assn, Shoreham Hotel, Washington, D C

Apr. 30-May 2—Meeting on Manned Space Flight Institute of the Aerospace Sciences, Hotel Chase St Louis Mo

May 1-3—Spring Joint Computer Conference, Fairmont Hotel, San Francisco

May 1-3—Biologistics for Space Systems Symposium, Biltmore Hotel Dayton Ohio Sponsor Aerospace Medical Research Laboratories, Aeronautical Systems Division AF Systems Command, Wright Patterson AFB, Ohio

May 2-4—18th Annual National Forum American Helicopter Society, Sheraton Park Hotel, Washington D C

May 2-11—International Space Research and Technology Exhibition, London England Sponsor British Interplanetary Society

May 3-4—First International Congress on Human Factors in Electronics, IRE, Lafayette Hotel, Long Beach, Calif

May 7-9—Materials & Processing for Space Environments Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St Louis, Mo

May 7-11—Annual Conference, Society of Photographic Scientists and Engineers Somerset Hotel, Boston, Mass Cosponsor AF Cambridge Research Laboratories

May 7-11—1962 Tool Exposition & Engineering Conference Public Auditorium, Cleveland, Ohio

May 8-10—12th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D C

May 8-10—Second National Conference on Peaceful Uses of Space, Seattle, Wash Sponsor National Aeronautics and Space Administration

May 11-12—Western Regional Convention Air Traffic Control Assn, Senator Hotel, Sacramento Calif Fly In Mather AFB

May 14-16—National Aerospace Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio

May 14-16—Joint Technical Society Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo

May 16-18—Spring Meeting, Society for Experimental Stress Analysis, Sheraton Dallas Hotel, Dallas, Tex

June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles Calif

Aug 21-24—Western Electronics Show and Conference, Institute of Radio Engineers Los Angeles, Calif

April 2, 1962

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COVER: Early wind tunnel test of a 1/128-scale model of an Apollo-type manned space vehicle in the Langley Research Center 20-in. Mach 6 Hypersonic Tunnel. Longitudinal aerodynamic characteristics were determined with the spacecraft attached to a Saturn C-2 launch vehicle. The C-2 has since been deleted from the National Aeronautics and Space Administration inventory, and the Apollo will be launched by C-1 in earth-orbital flights, and by C-5 in cislunar and lunar landing missions. Langley and Ames Research Centers conducted a large number of wind tunnel and laboratory tests to provide basic data for design of the Apollo vehicle

PICTURE CREDITS
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Mr. Vinson's Case for the B-70

(Defense Secretary Robert S. McNamara presented his case against the B-70 program in a special Pentagon press conference Mar. 15 (AW Mar. 26, p. 17). Rep. Carl Vinson (D-Ga.), chairman of the House Armed Services Committee, presented his rebuttal to Mr. McNamara in a speech on the House floor Mar. 21 in the debate on the military procurement authorization bill that was passed by a vote of 403 to 0. We are presenting here significant excerpts from Mr. Vinson's case for the B-70 program.—Ed.)

The actual issue that is presented to us is whether we should go along with a policy that would result in the long run in the extinction of bomber aircraft or whether we should provide a reasonable option for a continuation of bomber aircraft as a part of our strategic force. This is the sole issue.

I cannot stress this point too much. The $491 million which the committee recommends is not directed toward production which would lead to a large number of aircraft. What it would do is to provide development that will maintain a true option for a subsequent decision to go ahead with a full weapon system program.

To reach the $10 billion figure quoted by Mr. McNamara you would have to include cost of design, development and testing and you would have to procure and operate a large number of these aircraft for an extended period of time.

Now what happens if the $491 million is not made available? We will find ourselves at the end of Fiscal Year 1963 with a three year lag in engine deliveries, about a year lag in important areas of honeycomb panels for the airframe, a real possibility that critical tools will be disposed of, the plant facilities being used for other purposes and a concentrated skilled labor force scattered throughout the country on other jobs.

But if we do grant authority and these funds we will permit the start of development on strike-reconnaissance subsystems, we will permit a third airplane to change over from a B-70 type to an RS-70 type. The additional authority would also allow long lead time commitments for the fourth, fifth and sixth aircraft, and very importantly would permit a wide range of options in 1965.

Then in 1965 we will determine what course to follow—whether to produce airplanes or not—and we would be doing it on the base of factual knowledge. These options range all the way from completion of the sixth aircraft to going ahead to a full weapon system development program leading toward a force of actual fighting planes.

We are buying more than three additional airplanes. We are buying the critical element of time, perhaps as much as three years.

It is said that much of the equipment for the RS-70 still has to be developed. That is true. It is for this very reason that we need a larger program for the RS-70. Why should we wait until the third airplane is built before starting on the subsystems which need further developing. Let us save the time that is so valuable to our nation.

It is said that further research must be done on some of these elements before they are far enough along to initiate a development program aimed at actual operational use. This is not the case. These elements are within the existing state of the art.

For example, a very important part of the RS-70 is the high resolution radar. Now this radar which is concededly a very complicated device had its working model made by the University of Michigan many years ago. One company has even built and demonstrated in flight a system very similar to the one that would be used in the RS-70.

I can say, and this is important, that the quality of the radar picture obtained today is such that the radar operator can see and identify targets that cannot be seen at all with current systems.

We can all recall that very much the same arguments were made against the Polaris submarine years ago. If this Congress had not taken up for Admiral Rickover's ideas and supported him in his fight we would have no Polaris submarines today.

What the committee [Armed Services] has been trying to get across for two years is simply this. We think it is dangerous to get out of the bomber business entirely.

Consider this. Where would we have been five years ago if we did not have bombers? Where would we be today if we did not have bombers? In all probability we would have been attacked and would have been unable to strike back.

Today's B-47s, B-52s and B-58s have kept the peace. have been the one weapon that has deterred an enemy from attacking us. There is no doubt about the accuracy of this statement.

This is no special plea for the RS-70. If it were some other advanced bomber the committee would feel exactly the same way. The whole point of the committee's action is that we don't want to be entirely dependent on missiles—whether they be ICBM, IRBM, Polaris or any other kind.

And the very simple reason for this is that it permits us only a single way to fight a war. A missile cannot look at something and report back. It cannot turn around once it is shot off. It cannot do anything but go and explode its nuclear warhead. The last B-52 and the last B-58 will come off the production lines this year in August and October. We have over 1,000 of these bombers today. These bombers will wear out. If we do not start out on a new bomber then the time will soon come when we will have no bombers.

Perhaps the view of Armed Services Committee is an overly conservative one—perhaps the bomber has lost its glamor—but if the committee is going to push hard on one side or another it is going to be on the side of having too much rather than too little, having a strong conventional capability such as the bomber with man's brain guiding it rather than an electronic device which purports to have all the answers but which cannot ask a question.

WHO'S WHERE

In the Front Office

William W. Burton, vice president-administration, Rocket Power, Inc., Mesa, Calif.

Dirk J. Koeleman, a corporate vice president, KLM Royal Dutch Airlines. **Frits O. Kielman** succeeds Mr. Koeleman as the company's vice president and general manager in the United States.

Joseph M. Barr, a vice president, United Aircraft Corp., with offices in Washington, D.C., he will coordinate the activities of the company's operating divisions and subsidiaries. **James S. Lee** succeeds Mr. Barr as president of United Aircraft International, East Hartford, Conn.

Maj. Gen. John B. Medaris (USA, ret.), vice chairman of the board, The Lionel Corp., New York, N.Y. Until a successor is chosen, Gen. Medaris will continue as president and **Roy M. Cohn**, board chairman, will act as chief executive officer.

Carlyle A. Mounteer, vice president and general manager, Micro Systems, Inc., San Gabriel, Calif. Also, **Howard A. Nielsen**, vice president-marketing; and **Joseph C. Sanchez**, vice president-engineering, manager.

Robert F. Flood, executive vice president, Linde Co., a division of Union Carbide Corp., New York, N.Y.

Edward L. Klein, executive vice president, Mepco, Inc., Morristown, N.J.

Telemet Corp., Amityville, N.Y., a newly formed Giannini Scientific company, has announced the following appointments: **G. Richard Tingley**, vice president and assistant to Dr. Gianniui; **Jack Horowitz**, vice president-operations; **George R. Crofford**, treasurer; **Hans Schmid**, chief engineer, video; **S. S. Knusky**, Western Operations manager; **Harry V. Seaman**, chief project engineer.

John J. Casey, senior vice president-operations and a director, Seaboard World Airlines, Inc.

Honors and Elections

Dr. Charles H. Townes, Provost of Massachusetts Institute of Technology, has been awarded the National Academy of Sciences' John J. Carty Medal in recognition of his pioneering work in the development of the maser.

Changes

W. O. Rockhill, head of Computer Control Co.'s new Technical Communications Department, Los Angeles, Calif.

Melvin L. Keat, executive engineer, Aerospace Division, Vickers, Inc., Detroit, Mich., a division of Sperry Rand Corp.

Ermano Garaventa, assistant to the general manager, Hamilton Standard Division of United Aircraft, Windsor Locks, Conn.

Thomas J. Paganelli, general manager, General Electric Co.'s Heavy Military Electronics Department, Syracuse, N.Y., succeeding **Robert J. Brown** (AW Mar. 5, p. 27). Also, **Charles E. Beard**, manager of marketing, for the department.

L. H. Quick, assistant director of plans, Douglas Aircraft Co.'s Aircraft Division, Long Beach, Calif.

INDUSTRY OBSERVER

► Four companies—Bendix, Grumman, Hughes and Raytheon—are expected to submit proposals this month for development of 60-mi.-range air-to-air missile for Navy version of the TFX (AW Mar. 19, p. 23). General Dynamics/Pomona is working with Grumman, Ling-Temco-Vought and International Business Machines Corp. are associated with Raytheon. Air Force is expected to develop another missile for its version of the TFX, designed for a high-altitude intercept mission.

► **ARPA's Project Vela-Sierra, which deals with ground-based detection of high-altitude nuclear bursts, measures light intensity changes, atmospheric changes induced by radiation or debris, and electromagnetic radiation. Prototype network of stations for detecting, identifying and locating underground nuclear detonations, under the portion of the program designated Uniform, Project Vela, is expected to be operational in Fiscal 1963.**

► Aerojet-General Corp. has a contract from U.S. Army Ordnance for study and development of "bomblets"—small weapons carrying biological warfare agents and carried inside large bombs or warheads. Bomblets could be rocket-propelled for greater dispersion of BW/CW agents.

► Grumman W2F-1 Hawkeye early-warning radar aircraft is being offered in a modified version less its umbrella radome and one vertical tail surface as a transport for Navy COD (Carrier On-board Delivery) duty. Use of the modified W2F, which is powered by two Allison T56-88A turboprops, would permit attack carrier operations with all planes turbine-powered, reducing shipboard fuel requirements to one type.

► Decision to provide sea-based launch capability for mobile medium-range ballistic missile (MMRBM) may dash any Navy industry hope for funding Venus A (AW Mar. 19, p. 23). Warhead of Venus A is unconventionally positioned between the two solid-propellant stages and attached to the upper, whose nozzles are canted to avoid blast effects on the warhead during firing.

► Oscar 2, second amateur radio satellite now approved for launch by USAF, will be orbited from Vandenberg AFB as a piggyback vehicle aboard a Discoverer satellite not yet designated. During the three-week life of Oscar 1, over 5,000 tracking reports were filed by 600 stations in 31 foreign countries. Accuracy of amateur Doppler tracking was reported to be good.

► USAF Missile Development Center will start GEM (Guidance Evaluation of Missiles) program as part of its mission to establish the Central Inertial Guidance Test Facility. GEM will feature soft recovery of payloads including inertial guidance systems or components fired in standardized three-stage rockets with the third stage retrofiring to brake the payload to near zero speed at about 90 naut. mi. altitude. Trajectory will provide system-operations data under accelerations from zero to high g levels.

► Poland has developed a new helicopter called "Latka" for agricultural and forestry work, according to Soviet reports. Polish designers are also working on a new, small crop-dusting airplane.

► Foamed metals for energy-absorbing structures, sandwich core material and other specialized applications are being pushed by General Electric. Process produces interconnected-cell structure with densities and densities controllable over a wide range. Aluminum and magnesium foams are of greatest current interest, but high-temperature materials, such as some stainless steels, nickel alloys and even super alloys like Hastelloy X have been foamed.

► Current goal in cost-reduction program for the Martin Bullpup missile is to reduce the price per round below $2,000. High volume production and strict cost control have brought price down steadily from approximately $15,000 to the current figure. Bullpup is being manufactured by Martin Marietta's Orlando Division for Air Force and Navy, will soon be built in Europe for NATO forces.

Washington Roundup

Soviet Military Space

Soviet Russia is accelerating public discussion of the military usefulness of space, using the theme that the U.S. interest in military space weapons "compels Soviet strategy to explore military operations involving cosmic means." A number of articles and speeches stress that Russia's "global rocket" leaves the U. S. "wholly indefensible from the south, east and west."

The Soviet satellite launched May 16 at an inclination of 49 deg. to the equator instead of the usual Russian inclination of 65 deg. passed far enough south that it was not detected by U. S. radars in the Alaska area. It was not picked up until the third pass, about four hours after launch, when it crossed the Spasur "fence." Pressure for more satellite detection fences is expected to result.

USAF Chief of Staff Gen. Curtis LeMay, who has never been his service's foremost advocate of space weapons, said last week that the U. S. should recognize the advantages of developing military space systems as quickly as possible. "Whatever we do," he said, "the Soviets already have recognized the importance of these new developments and they are moving at full speed for a decisive capability in space. If they are successful, they can deny space to us. I don't believe it is necessary to dwell any longer on the strategic consequences of such a situation."

Russian Missile Sub

Contrary to recent public statements by top U. S. Navy officials, the Soviet navy has completed its first successful underwater firing tests of a solid-propellant missile from a nuclear-powered submarine. U. S. Navy still insists that Soviet missile-firing subs must surface to launch rockets. Soviet nuclear sub fleet is growing, with several vessels operating at sea at the same time from a base near Murmansk. The Soviet nuclear surface ship, the Lenin, which Russia claims is an ice-breaker, actually is a tender for the nuclear sub flotilla.

State Department estimates that Russia has sent 50 to 75 MiG jet fighters to Cuba.

Chinese have fired an intermediate-range ballistic missile over a distance of about 500 mi. It is believed to be one of the earlier Soviet designs, passed on to the Chinese by Russia.

RS-70 Study Chief

Air Force Undersecretary Joseph Charyk looms as the key man in the restudy of the RS-70 reconnaissance strike bomber program, ordered by Defense Secretary Robert McNamara to appease Rep. Carl Vinson, chairman of the House appropriations committee (AW Mar. 26, p. 16). He heads a team of USAF officials, RS-70 Systems Project Office personnel and 10 contractors who are to report back to McNamara late this month with proposals on the character and scope of the program. McNamara, anxious to counteract reports that the restudy is routine and was already under way before he announced it, said Maj. Gen. David Burchinal, USAF director of plans, will study operational uses of the system; Gen. Bernard Schriever, Systems Command chief, will be responsible for detailed analyses of alternative development plans, including plans for the integration of reconnaissance-strike components for flight tests and for possible flight tests of test aircraft beyond the three presently planned; and Brockway McMillan, assistant USAF secretary for research and development, will work on technical development of components, including side-view radar and data processing and display systems. Although McNamara did not name him, Maj. Gen. Robert Breitweiser, USAF deputy chief of staff for intelligence, also is on the Charyk committee.

Air Force plans for studies of a roving lunar vehicle and a lunar shelter have been scrapped. NASA raised strong objections to the vehicle study on the grounds that it duplicated work contemplated by NASA. The space agency is believed to have objected to the shelter study on similar grounds.

NASA Appropriations

Congress will make substantial cuts in the National Aeronautics and Space Administration budget for the first time this year. But current strategy calls for selective pruning rather than an overall cut. House space committee, which is readying NASA's $3.7 billion Fiscal 1963 authorization bill for a floor vote, will make the first reductions. Key members feel the bill will hit opposition in the House if it is left untouched, but think they can make the politically necessary cuts without subjecting themselves to charges of slowing the space program. Cuts may even be discussed beforehand with NASA officials to make sure that critical programs don't suffer. The money could be restored later if an urgent need arose. But the House appropriations committee, which will study the NASA budget next, may follow its traditional procedure and make across-the-board cuts in spite of the space committee's selective approach.

Communist sources in Russia and Hungary have sent post cards to a U. S. company asking for instruction booklets on a fuel gage whose part number identifies it as equipment on the U-2 downed in Russia in 1960. The requests were refused.

—Washington Staff

Industry Bids on Lunar Transport Study

Advanced vehicles for establishing base on moon would follow manned landing, use rendezvous.

By Irving Stone

Los Angeles—Industry proposals for a six-month, 12,000 man-hour study to investigate advanced lunar transportation systems using the Saturn C-5 launch vehicle plus nuclear propulsion for establishing a permanent base on the moon are being evaluated by NASA's Marshall Space Flight Center. Proposals were due last week.

The study will be based on the assumptions that rendezvous operations in earth and lunar orbits have already become proven operational techniques and that manned lunar landing has been accomplished. All launchings will be from the Atlantic Missile Range.

Specific purpose of the study will be to investigate and compare two possible follow-on approaches to the Saturn-Apollo transportation system now being developed for initial lunar landings. Premise underlying the study is that the Saturn-Apollo system is not suitable economically and operationally for the phase of space exploration that will require a permanent moon base. Marshall's aim is to draw on technologies stemming from the Saturn, Apollo and Rift (reactor in flight test) projects and follow-on nuclear developments.

The projected Nova vehicle also is being considered in the planning for advanced lunar transportation systems, but this planning will await the availability of more detailed data on Nova.

The two approaches specified for the study are:

- **Expendable system.** Booster would be a Saturn C-5 with an expendable Rift type of nuclear rocket as a third stage to put a payload of cargo, personnel, or a combination of the two into orbit around the moon. From this orbit the payload would be soft-landed on the moon by means of an additional stage which also would provide a capability for launching a manned payload from the moon for return to earth.

The nuclear stage would incorporate restart capability for braking into lunar orbit. The lunar landing and launch vehicle probably would use a liquid hydrogen-liquid oxygen propulsion system now under development.

Manned portion of payloads for this approach would be a modified Apollo command module which will have to accommodate a minimum of three men.

- **Re-usable system.** This approach would be based on the use of both earth and lunar orbits. A re-usable nuclear ferry vehicle would be put into orbit and fueled by earth-launched vehicles, also preferably re-usable. Cargo and manned payloads would rendezvous with the ferry and be transported to an orbit around the moon. After rendezvous with a re-usable chemical lunar shuttle vehicle, the ferry would transfer its payload to the lunar shuttle which also would be refueled by the ferry. The shuttle would transport the payload to the lunar surface while the ferry returned to an earth orbit in most instances retrieving a lunar crew which was being rotated. After the ferry transferred its payload to a vehicle for return to earth, it could be refueled for another mission.

The study contractor will not be required to submit design concepts for earth launched vehicles or their supporting operations since these data will be furnished by Marshall.

The re-usable system could incorporate the Rift type of propulsion scheme or a second-generation nuclear propulsion scheme known as Phoebus.

The lunar shuttle also would use a liquid hydrogen-liquid oxygen propulsion system and could land a manned payload of three men in a modified Apollo command module, plus a minimum of 10 tons of cargo.

The expendable and re-usable operational systems will be investigated in the following categories:

- **Trajectory and performance analysis.** Optimum orbital altitude for both earth and lunar orbit operations will have to be determined. Trajectory shaping for optimum efficiency will be required, including considerations to ensure a high probability of crew survival. Performance characteristics and requirements for each stage in the system will be determined.
- **Conceptual design and design criteria.** Analysis in this category will consider structural concepts to be used in all stages and subsystem design in sufficient detail to provide a basis for realistic estimates of weight and identification of potential problem areas.
- **Operational analysis.** This will examine each operational step to determine optimum procedures, reliability aspects and expected problems. The reliability analysis will consider failure possibilities and provide estimates of initial and ultimate reliability, reliability growth with time or missions, and total mission reliability.

Earth launch vehicle requirements must be determined in terms of number of successful launches, time-phasing of launches and payload types.

Funding Requirements

A development program must be outlined, including schedules and fiscal year funding requirements for each item of system hardware except for the earth launch vehicle.

Operational costs by fiscal year also will be required together with payload efficiencies in terms of dollars per pound of cargo and dollars per manned round-trip for personnel transport plotted against time.

Support requirements must be defined for earth orbit, lunar orbit and for lunar surface operations in terms of equipment, manpower and spare parts.

For the re-usable system, along recommendations must be made for best choice of reactor and power level for the application. Lifetime of the nuclear ferry vehicle and number of restarts must be estimated as well as recommendations for a method of replacing the nuclear propulsion system. The lifetime of the lunar shuttle vehicle also must be estimated.

Aerospace Surveillance

Three aerospace companies have been selected by Air Force's Electronic Systems Division to conduct separate funded studies of aerospace surveillance, under USAF planning study 7990.21 (AW Mar. 26, p. 20).

The three are North American Space and Information Systems Division, Northrop Corp. and Radio Corp. of America. They will share about $1 million allocated for the planning study which is expected to run about one year.

Purpose of the studies will be to investigate future integrated surveillance and tactical warning systems.

Site Selection Panel

Site selection panel headed by Air Force Flight Test Center Commander Brig. Gen. Irving L. Branch is meeting now to consider location of an Air Force Space Recovery Center.

Sites under consideration are Edwards AFB, Holloman AFB, N. M. and one near Wendover AFB, Utah. Edwards AFB which has a 15,000-ft. runway connecting to the 12-mi. long dry lake is considered the most likely choice.

STABILITY AND CONTROL characteristics of a flexible wing recovery system are evaluated in free flight tests of a ¼-scale model of the wing with an Apollo-type payload at NASA's Langley Research Center.

Rogallo Wing Picked for Gemini, Apollo

Washington—Rogallo wing landing system will be developed for Gemini and Apollo spacecraft to permit more flexibility in launch times by providing a capability for controlled ground landing after re-entry.

The need for ground landing was emphasized when below-minimum weather in ocean recovery areas delayed the Mercury Atlas-6 launch of Marine Lt. Col. John H. Glenn, Jr., seven times (AW Feb. 19, p. 30). Last week, Walter C. Williams, associate director of National Aeronautics and Space Administration's Manned Spacecraft Center, said a land landing is our goal" in Gemini and Apollo, and a parawing device is being developed for this capability.

The wing, named for Francis M. Rogallo of NASA's Langley Research Center, is being evaluated in drop tests and wind tunnel runs at Langley. Variations of the device are called flexwing and paraglider.

Wing Configuration

Specific wing configuration for Gemini spacecraft has not been established, but Ryan and North American have had the concept under study more than a year. It is expected that the wing will have a 45 to 50-ft. span and a lift-over-drag ratio of 4.5. Its maneuverability will be somewhat limited, with an expected range of 10-15 mi. from its re-entry path.

With the device the Gemini vehicle can be landed horizontally on skids with outriggers for stability. One project official said its handling characteristics will allow the spacecraft to land like a fighter-type aircraft with power off.

Parachute system will be used for initial Gemini flights, according to the present plan, with the wing to be phased into later systems. Although the wing is expected to be heavier and larger than the 96-ft. parachute originally seen as the recovery system, it will be packed in the same compartment. Leading edges will be inflatable.

Major Problems

Because there are obvious major problems in developing the wing system—deployment, structures, materials and sizing—development of the parachute recovery system will be continued. Experience in the Gemini program will be applied to development of the Apollo landing system.

The rapidly-developing Gemini program has been highlighted by these recent moves:

- **Attitude control system** development was awarded to Rocketdyne Division of North American Aviation. The system will be hydrogen peroxide, like that in the Mercury capsule, but will use ablative nozzles.
- **Martin Co.** was awarded a $170,000 contract to study effects of confinement and reduced physical activity on a three-man crew. This contract involves studies in a simulator for both Gemini and Apollo missions and will provide data on crew duty cycles and performance.

First increment of the letter contract was $50,000.

- **New pressure suit** was developed for Gemini crews. One early version has removable arms and legs for crew comfort and exercise.
- **Contract for rendezvous radar** for the Gemini vehicle is to be awarded soon.

First Gemini launch is scheduled for late next year, with rendezvous and docking missions starting with the fifth flight. Orbital altitudes will be 100-170 mi., about the same as Mercury orbit.

NASA, McDonnell Aircraft Corp. and Martin Co. representatives held a top-level Gemini progress meeting last week in Houston involving reports from systems and subsystems chiefs. McDonnell has the contract for the Gemini spacecraft and Martin for the Titan 2 launch vehicle to be used in the Gemini mission.

Slayton Qualification

Meanwhile, Project Mercury officials continue to emphasize privately their desire to qualify Air Force Maj. Donald Slayton for Gemini and Apollo missions. Maj. Slayton was eliminated as Mercury Atlas 7 pilot because of a heart flutter condition (AW Mar. 26, p. 18) four months after his selection.

NASA now is preparing to test the pilot under stress while his heart is fluttering, which should solve the main issue between NASA headquarters and the Manned Spacecraft Center—whether the condition affects Slayton's reactions or performance.

IRE/AIEE Will Vote On Merger Proposal

New York—Straw vote taken here during the Institute of Radio Engineers international convention last week on the question of merger of the IRE with the American Institute of Electrical Engineers revealed approximately 80% of the 400 persons who cast a ballot favored the merger with approximately 10% opposed and the remaining 10% undecided.

The straw vote followed a two-hour symposium at which IRE President Patrick E. Haggerty, who is president of Texas Instruments described in detail the merger negotiations to date and the anticipated benefits of the proposed merger. Warren H. Chase, AIEE president, also urged support for the merger.

Haggerty later told AVIATION WEEK that the results of the straw vote closely followed the results of smaller polls made at various section levels. Members of both technical societies will receive formal ballots early in May with the AIEE expected to announce the results of its membership vote in June 18 and the IRE to announce its ballot results on July 10. Approval of the merger will require that at least one third of the members of each society vote and that two thirds of those voting favor the merger.

The merged society, to be known as the Institute of Electrical and Electronic Engineers (IEEE) would have a membership of more than 140,000.

Solid Lunar Rocket Cost Estimates Given

Washington—Spokesmen for Hercules Powder Co. and United Technology Corp. told a House Science and Astronautics Committee last week that solid rockets capable of reaching the moon could be developed in six years for between $250 million and $300 million.

Dr. Lyman C. Bonner, director of development in Hercules Explosives Department, said the potential of solid motors is so promising that the decision on whether to use the orbital rendezvous technique for the lunar mission should be deferred until the potential for high thrust boost stages is much more nearly exhausted than it is today."

Bonner said the U.S. should develop a solid rocket of 20 million lb. of thrust which could reach the moon in one launch. Cost of developing such a rocket, Dr. Bonner said, would be about $275 million. He said the Apollo solid booster would be about 38 ft. in diameter, 150 ft. high and use about 10 million lb. of propellant. He said development, test and qualification of this rocket could be completed by mid 1967.

Lt. Gen. Donald L. Putt, USAF (ret.), president of United Technology Corp. and former chairman of the Air Force Scientific Advisory Board, said his firm could develop a two- to three-million-pound thrust solid motor and have it ready for flight testing during 1964. The cost estimate of $2 per pound of solid motor has been borne out as a reliable figure for production motors," he said.

Gen. Putt said the next logical development after the 120-in. strap-on solid motors for the Titan 3 is the 156-in. motor. UTC could flight test a 156-in. motor in 1964 and use it for manned space flights in 1966 if development were started immediately, he said. Clusters of the 156-in. motors would provide "up to 25 million lb. of thrust" and cost about $250 million to develop.

Once the 156-in. motors were developed, Gen. Putt said the next step would be motors of 300 in. to 360 in. in diameter. He urged starting a feasibility study of these large motors, estimating it would cost $50 million. UTC estimates it would take about six years to develop the 300-in.-motors.

Umbaugh Finances Questioned in Litigation

Baltimore—Cash resources of Umbaugh Aircraft Corp. and other companies associated with it in the U-18 gyroplane project are insufficient to permit mass production now of the aircraft, directors and officers of the companies have testified in court hearings here.

While there was considerable disagreement as to exactly what the cash assets of the various companies are at present, it was generally agreed that additional money will be needed to permit volume production as envisioned by Raymond E. Umbaugh, president of the Umbaugh Aircraft Corp. and promoter of the project. Limited production, according to Umbaugh officials, is to begin this spring or summer. Up to 120 demonstrator models of the U-18 are to be built. Umbaugh has said that up to 10,000 aircraft per year eventually will be produced.

Umbaugh Aircraft Corp. is seeking an order from a Maryland state court to restrain four distributors from continuing alleged interference in the activities of the corporation. Umbaugh charges their actions and litigation have caused delays in the U-18 production program and have virtually wrecked the company's ability to obtain financing.

The four distributors, Veigh Cummings of Salt Lake City, Utah; Roy Kaufman and Alfred W. Waddill, Jr., of Houston, Tex. and Gordon Allen of Baltimore, claim that Umbaugh made fraudulent statements and claims in inducing them to invest money in the program and that the Umbaugh Aircraft Corp. is now insolvent and unable to repay them. They are asking the court to take over the affairs of the corporation and appoint a receiver.

Specific charges include the claim that Umbaugh told them he was financing development of the U-18 largely out of his own pocket rather than with distributor deposits and that he promised delivery of aircraft at dates he knew to be unreasonable in order to secure deposits on aircraft (AW Apr. 17, 1961, p. 34). Dissatisfied distributors also allege that Umbaugh, in addition to using aircraft deposits for developmental work, has diverted sums of company funds to his own personal use.

Umbaugh Aircraft Corp. filed the Maryland suit Oct. 4, 1961, after the distributors announced their intention of seeking a bankruptcy hearing in federal court. Umbaugh Aircraft then was located at Hagerstown, Md., later moved to Bartow, Fla. Another court action is under way in Florida.

In January and February, directors of Umbaugh Aircraft Corp. formed Peace River Manufacturing Corp. and set up the Umbaugh Dealers' and Distributors' Trust. Peace River subsequently purchased from Umbaugh Aircraft Corp. design rights, tooling and the exclusive manufacturing rights for 15 years for the U-18 along with an option on an additional 15-year manufacturing rights for $40,000.

The Florida court which previously ordered Umbaugh Aircraft Corp. not to move its assets beyond the jurisdiction of the court, held that the sale to Peace River violated the order and issued contempt citations against both corporations and then boards of directors. The court gave those cited until April 1 to cancel the sale or to deposit $39,800 with the court.

Raymond E. Umbaugh is not a stockholder in Peace River but has an agreement with stockholders allowing him to purchase all outstanding stock for a total of $50,000 after two years.

In the Baltimore hearing, Kenneth Irving of Muncie, Ind. treasurer of Umbaugh Aircraft Corp., testified that as of May 12, last date for which figures were available, Umbaugh Aircraft had approximately $60,000 cash on hand and that Peace River Manufacturing Corp. had approximately $99,000 cash on hand.

Irving testified that as far back as July, 1961, Umbaugh had indicated to him that Umbaugh Aircraft Corp. had no funds to go into production and planned to raise funds by selling demonstrator aircraft.

Kennedy Orders Geodetic Satellite Probe

By George C. Wilson

Washington—Major policy differences on the Defense Department's geodetic satellite program are straining civilian and military space relationships so severely that President Kennedy has directed the National Aeronautics and Space Council to investigate the dispute.

NASA sponsored an Army Ballistic Missile Agency flashing light geodetic satellite project from the time NASA was formed late in 1958 until after the satellite became a joint NASA-Defense Department project in 1960. When Defense decided to classify the project secret, NASA withdrew.

The President's interest is likely to lead to declassification of the program to map and measure the earth through the use of satellites. Dr. Harold Brown, director of Defense Research and Engineering, told AVIATION WEEK a review of the secrecy decision is already under way. But he said there was no plan to turn the geodetic satellite effort back to the National Aeronautics and Space Administration because "We need it."

E. M. Cortright, deputy director of NASA's office of space sciences, said NASA also is exploring the nation's needs for geodetic satellites through meetings with Defense officials.

NASA came under such heavy criticism recently for not pursuing the geodetic satellite program that the House Science and Astronautics Committee has decided to hold special hearings. Rep. Joseph E. Karth (D.-Minn.), chairman of the subcommittee overseeing such satellite programs, said he will hold the hearings—probably this week—with NASA, Defense and Coast and Geodetic Survey officials as witnesses.

President Kennedy became interested after several scientists declared at the House space committee's Panel on Science and Technology on Mar. 21 and 22 that NASA was ignoring an excellent opportunity for international space cooperation in failing to pursue the geodetic satellite program.

Dr. Fred L. Whipple, director of the Smithsonian Astrophysical Observatory and Harvard College Observatory, said the program is "a rare opportunity for a true international cooperative program that would be definitely for the benefit of our knowledge of the earth as it applies to space." He urged NASA to launch a geodetic satellite saying "We have had the capability for at least three years."

Dr. James A. Van Allen, Iowa State University physicist whose instrumentation in early Explorer satellites detected the earth's radiation belts, said NASA's inaction on geodetic satellites "constitutes almost a national dereliction."

Dr. George B. Kistiakowsky, who was scientific adviser to former President Eisenhower, said there was no excuse for the military to keep geodetic satellite information secret. He said the secrecy could not be justified on the grounds that the satellite would help the enemy pinpoint U.S. targets.

"Considering the radius of damage from thermonuclear weapons," Dr. Kistiakowsky said, "it is perfectly obvious that the accuracy for targets is already adequate. Being able to provide an accuracy of something like 25 to 50 ft. is quite unimportant redundant and unnecessary from the point of view of military target locations, but has a tremendous importance in the study of the earth as a completely unclassified world-wide effort."

Rear Adm. James C. Tison, Jr., deputy director of the Coast and Geodetic Survey, said "we are definitely of the opinion" that the geodetic satellite "should not be a classified project, and we feel very strongly that we should go ahead with it as a nation."

Dr. Van Allen said the military should be asked to defend the secrecy which "has been the cause for the now five-year delay in making a go of this enterprise."

A panel of the U.S. National Committee for the International Geophysical Year recommended in 1957 that satellites be launched for geodetic purposes. The Space Science Board of the National Academy of Sciences recommended early in 1959 that NASA launch geodetic satellites. As early as 1956, the Army began work on such a program and made actual geodetic calculations with the Vanguard and Explorer satellites launched in 1958. The combined NASA-military interest led to the formation in 1960 of Project Anna—standing for Army, Navy, NASA and Air Force.

Deputy Secretary of Defense Roswell L. Gilpatric issued a directive on Mar. 28 of last year assigning the various services their responsibilities for reconnaissance, mapping and geodetic programs. Under the directive, Air Force develops and launches most satellites. Army maintains the geodetic control systems, draws the maps and provides detailed specifications for the mapping and geodetic satellites, and Navy provides the sea equipment and stations.

Although that directive has been in effect one year, there is a real question of how fully the Defense Department plans to carry out the mapping and geodetic satellite programs. NASA and Defense have been meeting over the last few days to discuss the nation's long range needs for such a program.

President Kennedy's interest may well lead to NASA's rejoining the geodetic satellite program, especially in the light of recent attempts to achieve more U.S.-Russian cooperation in space ventures. The President is being briefed on the geodetic satellite controversy by the space council.

Dr. Whipple said artificial earth satellites already launched have shown the gravitational behavior of the earth and thus helped determine the earth's shape. They also have provided a third point for making triangular calculations of distances. But he said no satellite so far launched has been designed especially for geodetic purposes. He recommended launching a flashing light satellite which would facilitate precision observations by ground stations.

"A flashing light satellite," Whipple said, "having flashes predetermined and coupled with a small extension of our present communication system, could make possible precision geodetic measurements by literally hundreds or even thousands of observers supported in their own countries throughout the world. Analysis would probably be confined to a few of the larger centers, but it could be carried out by any country in the program. The observational material would be made easily available on a world-wide basis as was done in the IGY program."

Conventional measuring techniques, Whipple said, locate positions on the earth to within about 500 ft. on a world-wide basis while island measurements sometimes are off by a mile or more. He said precision observations of satellites, besides determining the shape of the earth, would relate the geodetic networks on various continents to within an accuracy of 30 to 50 ft.

Soviet Space Crews

Moscow—Space flights of Russian crews composed of pilots, radio operators, scientists, engineers and doctors will be arranged by the Soviet Union "soon," according to Col. E. Petrov, who was identified by the official news agency Tass as "one of the leaders of a group of Soviet cosmonauts."

Writing in the Russian military journal Red Star, Petrov indicated that there may be more one-man flights before crews are flown. He noted that the role of a cosmonaut as a pilot "increases immeasurably."

Senate Space Committee Agrees On Compromise Comsat Measure

Washington—Legislation equally dividing ownership and control of a satellite communications corporation between communications common carriers and the general public will be recommended to the Senate this week by the Senate Aeronautical and Space Sciences Committee.

The major and controversial issues (AW Mar 26, p 23) were unanimously settled by the group last week. Sen. Robert Kerr (D-Okla.), the committee chairman, pictured the measure as "a compromise with which no one is entirely satisfied but against which there will be no united and vigorous opposition."

The corporation would have one class of stock, 50% owned by the common carriers and 50% open to purchase by the general public. The maximum price would be $100 a share.

The same dividend rate would be applied to both the carrier held and the public-held stock. Carrier investment in the corporation could not be reflected in the rate base for service charges. This arrangement for earnings, Kerr said, will give an incentive to carriers participating in the corporation's management to make it a profitable business.

Appeal Provision

No limit would be placed on the amount of stock owned by an individual carrier. If one carrier felt a disproportionate amount were held by a competitor, it could petition Federal Communications Commission. FCC would have authority to compel sale to the petitioning carrier for a fair price.

The corporation would be managed by a board of 15 directors, who would decide the amount of the stock issue. Six of the directors would be voted by the holders of public stock, six by the carriers, and three would be appointed by the President and subject to Senate confirmation. No single carrier could vote for more than three directors—a provision presumably aimed at keeping the representation of American Telephone & Telegraph Co. on the board to a maximum of three out of 15.

FCC would authorize establishment and ownership of ground stations by the satellite corporation, individual carriers, or carriers jointly. FCC would be told to encourage ownership by the common carriers where this is consistent with the public interest.

The satellite corporation would negotiate communications arrangements with foreign nations, with knowledge and cooperation of State Department.

Administration Compromise

Many of the provisions included in the Kerr bill were suggested or concurred in by Attorney General Robert Kennedy after legislation originally proposed by the President for broad public ownership and tight political control was confronted with strong opposition, and a growing movement developed to turn complete ownership over to the common carriers (AW Feb. 12, p. 26).

The measure approved by the Kerr committee will be referred to the Senate commerce committee, headed by Sen. Warren Magnuson (D-Wash.). The full commerce group will participate in hearings to be presided over by Sen. John Pastore (D-R.I.), chairman of the subcommittee on communications.

Meanwhile, a new drive for government ownership, led by Sen. Estes Kefauver (D-Tenn.), was under way in the Senate. Hearings before the Anti-trust and Monopoly Subcommittee, headed by Kefauver, are scheduled to continue this week.

Bids Asked on Nova Study Contracts

Washington—Fifteen companies have been invited to submit proposals for a detailed, six-month study of the three-stage Nova launch vehicle with bids due Apr. 26 and two parallel contracts to be awarded in May.

Proposal requests were sent Mar. 28 to Aerojet, Bell, Boeing, Chrysler, Douglas, Ford, General Dynamics/Astronautics, Grumman, Ling-Temco-Vought, Lockheed, Martin, McDonnell, North American Aviation, Northrop and Republic Aviation.

National Aeronautics and Space Administration restricted its invitation list to companies capable of a follow-on hardware contract. The agency said this was done to obtain the outlook of those with hardware experience. A separate contract, not restricted to winners, will follow for hardware and development.

Specifications call for cost sharing, and each company must state how much it is prepared to spend of its own funds. NASA will spend $700,000 on each contract. This is the largest contract in which NASA specifically asks for cost sharing although companies involved in the Apollo study spent several million dollars of their own money.

Successful bidders will coordinate with each other and NASA to perform these major study tasks:

- Develop a detailed set of criteria and model specifications for the three-stage vehicle, including a detailed preliminary design.
- Define a management plan, fabrication and testing methods, and major facilities and equipment needed for manufacture.
- Define reliability techniques and how they are to be developed with only a few research and development flights.
- Define the test program, transportation system and launch schedule.

Winners will have access to all previous conceptual studies of the Nova vehicle, whose general configuration was decided upon early this year. Without a payload, the vehicle will be about 300 ft. high and 45-50 ft. in diameter. First stage will be a cluster of eight Rocketdyne F-1 engines, each of which develop 1.5 million lb. thrust. Second stage will be four Aerojet hydrogen-oxygen M-1 engines, each developing 1.2 million lb. thrust. Third stage will be a single Rocketdyne hydrogen-oxygen J-2, developing 200,000 lb. thrust. Pad weight of this configuration is 9.5 million lb.

The N-3 stage containing the single J-2 is being developed by Douglas and is the only stage contract awarded for the vehicle.

NASA's Marshall Space Flight Center is managing this study contract. The center received proposals Mar. 26 from General Dynamics/Astronautics, Lockheed and Martin to develop and produce the Rift (reactor in-flight test) stage (AW Mar. 19, p. 31).

Ionospheric Probe Fired From Wallops

Washington—Ninth four-stage Scout development vehicle successfully carried an ionospheric probe to a 3,910-mi. altitude after launch from Wallops Island, Va., at 2:27 a.m. Mar. 29. Flight time for the 147-lb. payload was 79 min., and the package landed in the Atlantic 4,370 mi. from the launch site.

The probe, designated P-21A, was designed to provide night information on electron density, ion density and ion type, to supplement information from the daylight P-21 ionospheric probe launched last October. They are expected to contribute to description of a model ionosphere.

Next Scout shot from Wallops is scheduled to carry an advanced Transit prototype satellite into orbit for the Navy.

McNamara Attacks Renegotiation Policy

By Katherine Johnsen

Washington—Renegotiation is causing "serious problems" that threaten the effectiveness of Defense Department's new program to cut procurement costs by stimulating contractor efficiency and responsibility, Secretary of Defense Robert S. McNamara has told the House appropriations subcommittee on the armed services.

Defense's new incentive system would reward contractors with up to 15% profit for excellence of performance, and assess penalties for poor performance (AW Mar. 26, p. 19).

In the past, the so-called "merit" earnings of aerospace manufacturers have had little significance because they were ordered refunded by the Renegotiation Board. This resulted from the board's measurement of the companies' total annual profit against net worth as directed by renegotiation law.

During the 1952-56 period, the board directed refunds by seven major aerospace companies totaling over $150 million. The cases are now pending before the U.S. Tax Court. In the first decision, involving the 1952 profits of the Boeing Co., the Tax Court generally upheld the Renegotiation Board and ordered a $13 million refund (AW Jan. 22, p. 32). Boeing is now seeking a review by the full 23-member court.

After reporting to the subcommittee that cost overruns on major aerospace programs have been between 300% and 1,000% and that Defense hopes to correct the situation by the incentive system which will reward cost responsibility in bidding and performance, McNamara said in testimony released last week:

"We have some very serious problems on renegotiation brought about by the recent action of the board and the Tax Court with respect to the Boeing case. This is extremely important to us. I am very much concerned about it. It could, if it stands without modification, undermine our entire program to place increasing emphasis upon cost reduction by providing incentives and penalties to the contractors in relation to the extent they do or do not meet our objectives, financial and otherwise."

In cost estimating, McNamara said he was "very embarrassed to see how far out of line we are ... particularly on Atlas and Titan. Within the last several months costs have risen far in excess of what had been estimated."

Another example, McNamara said, is the USAF-Douglas Skybolt air-launched ballistic missile. Initial estimate a year ago for research and development approximated $170 million. "It had increased to $390 million by August of last year, and by October ... probing indicated it would be $493 million, which is the present program," he said.

The cost estimates on the B-70, McNamara said "are roughly 100% per airplane more than were estimated a year ago."

McNamara told the subcommittee that if and when he ascertains a contractor has submitted a low cost proposal with the thought of increasing the cost after he has won the award, "I will really lower the boom on him."

The secretary indicated that there will be no restraint in levying penalties when they are warranted under the incentive system. He said "we are operating a profit and loss economy" and not just a profit economy.

McNamara's view on renegotiation is at odds with that of the Administration which has requested a four-year extension of the law without amendment. The present act expires June 30.

The secretary's statement angered some members of Congress. It is an "unbelievably presumptuous" one congressman said. "He presumes to tell the federal judiciary what it should do. He presumes to tell the Renegotiation Board which functions under a law laid down by Congress what it should do."

The leading advocate of renegotiation is Rep. Carl Vinson (D-Ga.), chairman of the House Armed Services Committee with whom McNamara has already had a serious clash over the B-70 program (AW May 26, p. 17).

McNamara also supported Defense Department's extensive use of non-profit organizations. A comprehensive study of this by the Bureau of the Budget is now being reviewed by the White House. It was ordered last August by the President, following widespread criticism in Congress of the increasing use of non-profit firms, particularly by the Air Force (AW Jan. 15, p. 30).

McNamara anticipated that the White House study by "throwing further light on the need for and operations of these non-profit corporations, will be worthwhile. They are a very important factor in our Defense Department operations now ... very important in terms of contribution to the development of our defense program and the progress of that program."

Other testimony before the subcommittee headed by Rep. George Mahon (D-Tex.), included:

- **Air Force assumed** responsibility for overestimates of USSR bomber capabilities in the mid-1950s—which powered USAF's drive for a bigger U.S. program to fill the so-called "bomber gap"—and expressed apprehension that representatives from the three military services may be excluded from the U.S. Intelligence Board, which establishes the national intelligence estimates.

Gen. Frederic H. Smith, USAF vice chief of staff, told the subcommittee that "the Air Force was wrong on the long-range bomber capability of the Soviet Union some time ago." Air Force Secretary Eugene Zuckert noted that many past USAF estimates have been correct particularly its assessment of Russian scientific capability.

Elimination of the services from the Intelligence Board is "under active discussion at the present time," Zuckert said. This would mean that service expressions of dissent would have to channel through the director of the Defense Intelligence Agency.

- **USAF is "running into trouble"** on the Midas infrared missile warning satellite, Zuckert said. It is understood USAF has earmarked only $100 million for the program for Fiscal 1963—half the amount allocated for the current fiscal year. Zuckert said there is technical disagreement as to whether the project ever reaches the state of the art.
- **Although a space orbital bomber system** is under "very heavy study," according to Lt. Gen. James Ferguson, USAF deputy chief of staff for research and technology, "we are not clear it is sufficiently advantageous in terms of improving our total offensive capability to undertake the development at this time."

Gen. Smith said "the accuracy of such an orbital bombardment system will initially be of a very low order indeed as far as delivery on precise spots is concerned."

Variable Geometry Wing

London—Ministry of Aviation has placed a design study contract with British Aircraft Corp. for research into development of a variable geometry wing aircraft (AW Mar. 12, p. 27?).

Minister of Aviation Peter Thorneycroft told Parliament that placing of the contract does not mean Britain will build or be committed to build such an aircraft but that detailed information was needed for the basis of future decisions.

Vickers-Armstrongs has done considerable work in this area with a variable geometry design team headed by Dr. Barnes Wallis, designer of the Vickers Swallow variable geometry aircraft (AW Jan. 11, 1960, p. 31).

Hawker Siddeley also has been working on variable geometry as a company-funded project involving a Mach 1.1 design.

MMRBM to Use New Development Plan

By Philip J. Klass

Washington—New approach to the development of complex weapon systems will be used for the mobile medium-range ballistic missile (MMRBM), at the insistence of the Office of the Director of Defense Research and Engineering. It is intended primarily to prevent large time and cost overruns that have characterized most of the major defense programs in the past decade.

Air Force is revising its MMRBM requests for proposals to industry to reflect this new approach and is expected to submit them soon for approval to Assistant Secretary of Defense John H. Rubel, who is deputy director of defense research and engineering.

The MMRBM project resulted from a request from USAF Gen. Lauris Norstad, supreme allied commander in Europe and commander-in-chief of the U. S. European command, for development of a missile to replace tactical aircraft on the Continent. Last October, Secretary of Defense Robert S. McNamara ordered the Air Force to write specifications on which to base requests for proposals which would be sent to industry but defense officials considered the first result inadequate and ordered the rewrite (AW Mar. 26, p. 16).

Under the new plan, Air Force will be authorized to select contractors and award contracts initially only for a "program definition phase," expected to last several months or more.

The objective of this phase is to bring together contractors for all major elements of the system to conduct trade-off studies that will resolve, or at least reduce, the many unknowns concerning the best technical approach and to produce more definitive specifications for the weapon and its operational deployment.

Only after the technical approaches and their effect on deployment philosophy, development time and cost and overall weapon effectiveness have been more thoroughly analyzed is the Defense Department expected to authorize USAF to proceed with the hardware development phase.

Current thinking is that only one contractor will be selected for the integration, assembly and checkout (IAC) task in the program definition phase, but two or more companies may be selected for the other subsystem areas—guidance, command and control, reentry vehicle, propulsion and erector transport vehicle. The higher-risk, more difficult areas such as guidance will have at least two contractors during the initial phase.

But when the program progresses to hardware development only one contractor is expected to be selected for each task, from among the initial phase contractors.

This new approach results from McNamara's program aimed at cutting development time and cost and to perform system effectiveness and feasibility studies before major programs are committed (AW Feb. 5, p. 26).

Changes Recommended

In response to a McNamara directive of last fall, Rubel issued a memorandum to each of the services which recommended a number of changes intended to improve the situation (AW Feb. 5, p. 26).

In accordance with McNamara's authorization to establish one or more controlled experiments to determine the benefits of new management techniques and controls the Titan 3 space vehicle was picked as the first guinea pig program.

The Titan 3 program definition phase already has indicated the need for two major changes in program objectives, illustrating the payoff of this approach, Rubel told Aviation Week.

But the MMRBM program will be the first complex weapon system to be developed under the new philosophy. Rubel conceded that there have been a number of studies on various aspects of the MMRBM within the Air Force, in the Defense Department and by the Aerospace Corp. Three companies currently are under contract for studies of the MMRBM guidance problem—AC Spark Plug Division of General Motors, Kearfott Division of General Precision and United Aircraft Corp.

MMRBM Mission

Washington—Mobile medium-range ballistic missile (MMRBM) is intended to replace existing tactical aircraft for use against enemy missile sites and similar targets in a limited war and not as a deterrent weapon for the North Atlantic Treaty Organization, contrary to widespread belief.

The MMRBM is expected to carry a comparatively small nuclear warhead and be designed for pinpoint accuracy so it can destroy its assigned target without widespread destruction of the surrounding area.

Defense Department has budgeted approximately $100 million in Fiscal 1963 funds for its development, with the stipulation that no more than $50 million will be expended during the first year. Initial program definition phase will be covered by Fiscal 1962 funds, totaling about $6 million.

While such studies are worthwhile up to a point, Rubel believes that they often fail to come to grips fully with problems unless conducted by contractors who are likely to be involved in the later hardware development program.

Studies to date have shown that there are half a dozen different possible MMRBM designs, each with certain tactical or operational advantages and disadvantages. In part this variety stems from the five different possible guidance system approaches which could be employed for the land-based missile. And the optimum choice for it may not be the best for the ship-based version of the MMRBM.

These guidance subsystem approaches range from an all-inertial system to combination inertial-stellar, with single-star or two-star optics. Each has certain advantages and certain disadvantages and several involve techniques never tried before on a ballistic missile. Particularly important is the fact that the choice of guidance system will affect the missile's operational deployment, its payload, its accuracy and its reliability.

Information Flow

What has been lacking in studies to date, Rubel said, is the cross-flow of information between the six major subsystem contractors to permit each to make realistic design trade-off analyses.

Under the new philosophy, the selection of a complete family of subsystem contractors, with two or more companies working in many of the technical areas, will provide the opportunity for mutual exchange of information. This will enable each to determine the effect of its design alternatives on other subsystem contractors, and the net effect on over-all missile performance and deployment practices, Rubel believes.

Originally the Air Force proposed an arrangement more in keeping with its traditional procedures for such development programs, but Rubel rejected this last month. The Air Force plan called for releasing requests for 250-page industry proposals for the full program, including hardware development, based on specifications already prepared.

After studying industry proposals, Air Force planned to select the more promising contractors, revise its specifications and then hold a second proposal competition for the most promising contenders. Contractors would then be selected for each of the six technical areas and contracts awarded for hardware development. Rubel vetoed this because it would involve industry in two rounds of costly proposal preparation, an exercise which both the Pentagon and industry itself condemn as a waste of top talent.

The emphasis in industry during this period would have been on brochuremanship rather than on analyzing the problem, Rubel believes.

Several top Air Force officials, both in the Pentagon and in the Air Force Systems Command's Ballistic Systems Division objected vehemently to Rubel's action as arbitrary and an attempt to interfere in USAF's assigned procurement responsibility.

The decision was appealed to Rubel's direct superior, Dr. Harold Brown, director of defense research and engineering who fully supported him. Indications are that McNamara will support Rubel if the matter should be appealed to him, if only because of the cost and time records of development systems in the past few years.

In writing the order to the Systems Command implementing the new approach to writing the specifications and the changes in management procedures, Assistant Secretary of the Air Force for Material Joseph S. Imrie made it clear that Rubel guidelines were to be followed closely, but that he still felt the approach was wrong.

Air Force development programs, admittedly difficult ones, have been the major offenders in cost and time overruns according to Rubel. Little more than two years ago Air Force and Rubel locked horns when he refused to approve its program for developing the Skybolt air-launched ballistic missile.

Rubel charged then that the Air Force performance specifications were unrealistic and that its cost and delivery estimates were far too low. After a bitter verbal battle, Air Force agreed to make a more detailed study and later decided to ease its range and accuracy requirements as Rubel had suggested.

Despite the reduced program objectives, the Skybolt has experienced serious overrun problems both in time and cost. During the first 12 months of the Skybolt development its delivery slipped nine months.

Cost of the reduced performance program was estimated at $175 million only two years ago, but the current estimate to completion is nearly $500 million—almost three times the original figure.

These overruns are not the result of changes in program objectives or design approach, Rubel said. Before approval was given on the Skybolt program, Air Force was told that there could be no major changes in program objectives or performance specifications without Defense Department approval. The only major change to date, Rubel said, was the decision to use a gimbaled nozzle on the second stage instead of the four fixed nozzles as was originally planned.

Rubel believes that the MMRBM has many more unknowns today than the Skybolt program did at its inception and that the MMRBM presents a far more difficult design problem, particularly since it must be suitable for both land and ship based launch.

Recognizing that the MMRBM will be a multi-billion dollar program at best, Rubel emphasized that the nation cannot afford a cost overrun of several hundred per cent, with corresponding schedule slippage.

Latest Techniques

In accordance with the guidelines laid down by McNamara, Rubel intends to try the latest management techniques to improve both Air Force and Defense Department control of the MMRBM development effort. For example, program evaluation review technique (PERT) and a comparable cost analysis (PERT/COST) will be mandatory for all major contractors.

Rubel and others in his office also intend to monitor the program through and beyond the program definition phase. Before Air Force is authorized to proceed with the hardware development phase, the Office of the Director of Defense Research and Engineering intends to assure that MMRBM specifications are sufficiently detailed and realistic, utilizing panels of consultants where needed to supplement its own expertise.

Although the Air Force will be responsible for selecting contractors for the program definition phase and narrowing the field to the final hardware contractors, its selections will come under the scrutiny of the Pentagon.

Rubel is critical of "brochuremanship" and the tendency in the past to equate a company's ability to do a job with its ability to put together a convincing proposal. He said he hopes that the selection of contractors for the MMRBM will be based largely on "past performance and present posture." The latter includes the availability of qualified personnel, without diverting them from other important jobs or being forced to share them with other projects.

Another important factor, in Rubel's opinion, is the willingness of the companies to give the MMRBM program full project status within its organization.

One argument which Air Force officials used against Rubel's approach was that it would hurt their chances of driving a hard bargain with industry to set MMRBM contracts on a fixed-price or cost-plus-incentive-fee basis. Once the field has been narrowed to one or two companies for the initial phase, Air Force argued the companies would be more resistant to accepting such contracts for the subsequent phases.

Rubel believes that the direct opposite is more likely. With present loose MMRBM specifications, he doubts whether any company will take the job on a fixed-price basis and very reluctantly on a cost-plus-incentive-fee arrangement. Once the program definition phase is completed and the specifications are more firmly defined companies are more likely to accept such contract forms, Rubel believes.

In a recent conversation with a top Air Force official on the MMRBM program, Rubel was told that all development programs involve risk and areas of uncertainty, and that the Pentagon must expect overruns of 10-20%. Rubel, who spent many years in development work at Hughes General Electric and Lockheed, replied that any time an Air Force program experiences such modest overruns it need have no fears of being chastised by the Pentagon. He added that it is the overruns of 200%, 300% and more that his office is trying to prevent.

Lockheed Polaris A-3 Tests Slated

First in a series of more than a dozen experimental Polaris A-3 ballistic missiles will be test-fired from Cape Canaveral, Fla., in May or June. Range of these initial A-3 versions is expected to fall at least 200 naut. mi. short of the 2,500-naut.-mi. goal initially projected for this Navy Lockheed Polaris A-3 because first stage flame temperature had to be reduced to 6,000F as a result of the destructive effect on motor materials (AW Sept. 4, p. 31).

At the conclusion of the forthcoming series of tests, an A-3 model using a completely new, advanced formulation solid propellant which may yield higher specific impulse at the same flame temperature (6,000F) will be delivered to the Cape. The new propellant, combined with redesigned missile hardware, may bring the A-3 range close to the 2,500 naut.-mi. goal.

A completely successful firing of the A-3 first stage with its four rotatable nozzles was conducted last month by Aerojet-General. Burning time exceeded 1 min., corresponding to actual flight burning time of the Polaris first stage.

Studies are continuing at Lockheed on a more advanced Polaris A-3 version presently designated A-3A which would be capable of carrying a larger payload the full 2,500 naut. mi. Should Navy get funding for this Lockheed missile it is expected to be redesignated Polaris A-4.

NASA Wants Development Funds For Nerva Doubled in Fiscal '63

Washington—National Aeronautics and Space Administration is asking Congress to double its current budget for the nuclear rocket engine so technology can be translated into hardware in Fiscal 1963.

Harold B. Finger, director of the joint NASA-Atomic Energy Commission Space Nuclear Propulsion Office, recently told the House Science and Astronautics Committee that Fiscal 1963 "is really the start of the big development effort" on the nuclear engine for rocket vehicle application (Nerva).

NASA is asking Congress for $36 million for Nerva development in Fiscal 1963, twice the $18 million available for this fiscal year. There is little doubt Congress will appropriate almost everything requested for nuclear propulsion since key lawmakers look upon this field as one of the most promising for beating Russia.

In fact, during the current House space committee budget hearings, Finger had to assure Congressmen that NASA was asking for enough money for Nerva. "We are moving just about as fast as the technology will permit us to," he said. NASA hopes to complete Nerva ground tests in Fiscal 1964 and flight tests in the 1966-1967 time period.

For the remainder of this fiscal year, the Nerva program will emphasize liquid hydrogen tests of the type of reactor which ultimately will be incorporated in the flight engine. Questions about liquid hydrogen include its density temperature relationships, transport properties, dissassociation and recombination rates. These and other liquid hydrogen characteristics will figure in the design of cooling passages, pumps, reactor exchangers, flow meters and rocket nozzles.

With this knowledge in hand, Finger said NASA will begin major procurement for the Nerva engine in Fiscal 1963. The engine is being developed by Aerojet-General Corp. and Westinghouse Electric Corp. Contract for Rift (reactor in flight test), the stage which Nerva will power, is expected to be awarded soon (AW Mar. 19, p. 31). Finger said NASA will need about 30 to 40 reactor engine assemblies for simulated flight tests before the actual flight tests.

NASA expects to complete several tests of Rift components and complete a mockup of the design in Fiscal 1963, but not major fabrication and assembly. A major part of the Rift effort in Fiscal 1963 will be toward developing ways to integrate the reactor and the engine. Finger said reactor testing in the Nerva program is "approximately three months" behind schedule. The Kiwi-B 1A reactor test series was cut short because of a hydrogen leak. But Finger said the test results "were quite encouraging."

A major technical advance in the NASA-AEC nuclear propulsion programs Finger said would be development of materials that could operate with liquid metals and metal vapors at temperatures of 2,000 or 2,500F. Other major points made by NASA during the current House hearings on its $123 million budget (see chart) for nuclear programs:

• **Snap-8.** Finger said "our major effort at the present time is the development of the 30-kw. system with enough work on the 60-kw. version to show that such a system is feasible." The 60-kw. version consists of two 30-kw. conversion systems working off the same reactor. The 30-kw. version would yield one kilowatt for every 60 lb. of Snap vehicle while the 60-kw. model would yield one kilowatt for every 50 lb. This compares with the desired yield of one kilowatt for every 10 lb. of weight. NASA plans to flight-test Snap-8 in mid-1965. Endurance tests of the power conversion systems at full power will be conducted in Fiscal 1963.

Ultimately, NASA hopes to develop an auxiliary power unit which would provide at least one kilowatt for every 10 lb. of weight and remain operating for over a year at levels of at least one megawatt. The agency in Fiscal 1963 plans to investigate such advanced power systems as magneto-hydrodynamic generators and fission fragment converters.

• **Electrical propulsion.** NASA is investigating the arc jet, ion engine and plasma jet. Finger said in Fiscal 1963 his office will start developing a 30-kw. arc jet which could be combined with Snap-8 and then the whole package flight tested. Avco Corp. will develop the arc jet flight engine. Similarly, NASA in Fiscal 1963 will continue developing a 30-kw. ion engine which can be flight tested with Snap-8.

Finger said it may be possible during the same flight to test both the arc jet and ion engines.

The plasma jet, Finger said, is not as developed as the arc jet and the ion engines.

NASA intends to investigate several advanced concepts for plasma jets in Fiscal 1963.

Finger said a 30-megawatt electrical engine is needed for missions to the planets.

• **Dynamics and control.** NASA's budget for this advanced research activity is slated to rise sharply from $280,000 in Fiscal 1962 to $1,276,000 in Fiscal 1963. NASA will study ways of starting nuclear engines and reactors as well as integrating their control systems. Unknowns are the dynamic behavior of liquid hydrogen in a zero gravity field and the effects of high temperature on the systems.

• **Advanced concepts.** Emphasis will be on more research into gaseous core, dust bed and fluid bed nuclear reactors in an attempt to lift the temperature limitations on existing materials.

NASA Funding for Nuclear Programs

	Fiscal 1961	Fiscal 1962	Fiscal 1963
Advanced Research			
Nuclear propulsion:			
Hydrogen properties	$330,000	$400,000	$780,000
Radiation effects	761,000	806,000	1,940,000
Dynamics and control	120,000	280,000	1,276,000
Engine systems and components	810,000	980,000	2,471,000
Advanced concepts	650,000	690,500	1,562,000
Power generation			
Mechanical component research	416,000	728,000	1,810,000
Direct power conversion	215,000	520,000	1,540,000
Liquid metal research	290,000	670,000	1,720,000
Waste heat rejection	200,000	440,000	1,270,000
Advanced concepts	110,000	310,000	958,000
Total	$3,902,000	$5,814,500	$15,327,000
Advanced Technical Development			
Nuclear propulsion:			
Reactor test support	$4,495,000	$5,900,000	$5,500,000
Nuclear engine development	2,300,000	18,000,000	36,000,000
System, component technology	6,100,000	6,600,000	7,800,000
Propellants	2,105,000	2,700,000	12,500,000
Power generation			
Snap-8 development	2,400,000	6,000,000	7,000,000
Megawatt system design studies	50,000	200,000	710,000
Component technology	3,300,000	3,600,000	4,180,000
Total	$20,750,000	$43,000,000	$73,690,000
Flight Programs			
Snap-8 vehicle integration			$7,600,000
Rift development	300,000	1,300,000	25,700,000
Operational safety	98,000	120,000	645,000
Total	$398,000	$1,420,000	$33,945,000

Teller Urges Moon Reactor

Washington—Dr. Edward Teller, associate director of the Lawrence Radiation Laboratory, said last week that planning should start immediately on a nuclear reactor which would be sent to the moon in sections and then assembled to provide power for the first landing parties.

Anything sent to the moon costs its weight in gold, Dr. Teller told a House Science and Astronautics subcommittee, and therefore only the best tools should be launched. He said a reactor would be one of the most valuable tools that could be sent.

Dr. Teller said the reactor could melt down rocks and separate any water found into hydrogen and oxygen. These gases could be used to sustain life on the moon and perhaps to refuel space vehicles for the journey back to earth. Moon dirt could be used to shield the reactor, thus eliminating the need to launch the heavy conventional shielding. He said the moon reactor would weigh "a few tons" and take four or five years to plan.

Another valuable tool on the moon, Dr. Teller said, will be nuclear explosives. He said they could be used to change features of the moon's surface to facilitate landing and living there. He predicted the moon would become an all important way station for expeditions to the planets. "Whoever takes space seriously must take the moon seriously," Dr. Teller said.

Senate Group Votes Extra RS-70 Funds

Washington—Senate Armed Services Committee last week approved legislation authorizing a $491 million RS-70 reconnaissance-strike bomber program for Fiscal 1963—$320 million more than the $171 million now planned by the Defense Department.

The House has already approved the $491 million and obtained assurances from Defense Secretary Robert S. McNamara that a re-study of RS-70 would be made (AW Mar. 26, p. 17).

Sen. Richard Russell (D.-Ga.), chairman of the Senate committee, said that "after the re-study Mr. McNamara will probably put a little more into the program but it is my opinion that he will not use anything like $491 million."

The $12.9-billion authorization for Fiscal 1963 aircraft, missile, and ship-building procurement passed by the Senate committee was $96.4 million less than the amount voted by the House. Funds added to Administration requests by the House which were eliminated by the Senate committee were $55.3 million for Army aircraft, $31.1 million for Army missiles and $10 million for procurement of long lead-time items for 100 additional Minutemen.

Apollo Heat Shield

Washington—Avco Corp. has won a subcontract valued at more than $8 million from North American Aviation's Space and Information Systems Division for design and construction of the Apollo re-entry vehicle heat shield.

The shield will be made of a high temperature charring ablative material of phenolic resin and glass fiber (AW Mar. 12, p. 177).

News Digest

Lockheed Georgia Corp. has been awarded a supplemental contract for $94,551,368 for SC-130B and C-130E turboprop aircraft, a mobile trainer and related spares. The SC-130B aircraft will be assigned to the Air Rescue Service and the C-130E aircraft will be used for both long-range strategic and short-range tactical airlift.

North American RS-70 joint test force, similar to that established for testing the B-58, soon will be set up at Edwards AFB, Calif. Head of the test force will be Col. Guy M. Townsend, presently assigned to Strategic Air Command headquarters.

Nord Noratlas will be converted to a VTOL testbed, using Rolls-Royce jet lift engines hung in pods under the wing by Short Brothers & Harland and Whitworth Gloster, under Ministry of Aviation contract. Engines probably will be RB.162s.

Air Force is selecting eight test pilots to attend the second six-month Aerospace Pilots' Research Course at Edwards AFB, Calif. Five pilots were graduated from the first class last fall.

Fairchild Stratos Corp. will build 12 additional F-27 turboprop transports on the basis of firm orders and projected market requirements. By continuing production the company keeps the door open for possible military procurement.

First live ejection at supersonic speed (870 mph.) from a Convair B-58 was made Mar. 21 at Edwards AFB by a black bear which returned to earth unharmed in the fully-enclosed capsule built by Stanley Aviation Corp. Bear, selected because its internal organs and spinal column are similar to those of man, received less force and had a smoother "ride" than did Chief Warrant Officer Edward J. Murray at subsonic speed (AW May 5, p. 26).

Shinn Engineering Co., manufacturer of the Shinn 2150A, has suspended production of the two-place aircraft. Financial difficulties in one of the company's other divisions caused production to be halted after the manufacture of 35 aircraft.

American Bosch Arma Corp. and Standard Kollsman Industries officials have held initial discussions to explore possibility of a merger. Arma has been in the merger mood for at least several years since negotiations with Northrop fell through at the last moment. Two companies have combined sales exceeding $200 million annually.

Congressional Report Challenges Merger

Possible monopoly, influence of lenders cited in House unit study of American-Eastern combine.

By Robert H Cook

Washington—First serious challenge to the proposed American Eastern merger was presented to the Civil Aeronautics Board last week in a strong denunciation of the plan by a House anti trust subcommittee staff study.

Indications that these airlines may face a more searching and comprehensive line of questioning than past merger applicants experienced were contained in the study, which termed the proposal "unprecedented" in comparison to past airline mergers.

In a detailed critique requested by Chairman Emanuel Celler (D N Y), the staff study based its opposition to the merger primarily on grounds that it would create a monopolistic "supercarrier" subject to possible influence from a small group of major insurance companies and banks (AW Feb 5, p 43).

CAB approval of the United-Capital merger, under the "failing business" doctrine, was upheld by a Court of Appeals decision because of Capital's financial ills which threatened bankruptcy of the airline, the study noted.

Eastern's Position

In contrast, the study pointed out, Eastern is a "powerful, aggressive airline with vast resources" and despite a $13-million loss over the past two years expects to earn an annual profit of $10 million beginning this year and extending through 1970 (AW Mar 26, p 26). This optimistic financial forecast was filed with the CAB by Eastern only three weeks ago, the study emphasized. Applying other measures of the 'failing business" doctrine, the subcommittee staff found that Eastern had not any of the 14 different situations considered necessary for a merger approval.

Competitive impact of the merger would have a far-reaching effect on the remaining smaller airlines the study contended, in that it would concentrate nearly 60% of the revenue passenger miles in the hands of the American-Eastern combine and United. With the addition of Trans World Airlines' traffic these three carriers would capture almost 75% of the domestic traffic leaving this vital national industry under the domination of three Goliaths," the staff said.

This would leave the seven remaining trunklines to compete for only 25% of the domestic market, against the larger and more powerful American-Eastern combination.

Significantly, the staff emphasized, all smaller trunks already are competitors of one or both merger parties.

The study pointed out that American would also expand its operations into nine of the top 10 airline markets, with a total of 74 monopoly markets created as a result of the merger. In addition, American would be in a position to compete in a southern transcontinental service and would have sufficient aircraft to switch large fleets from one major route to another, in order to take advantage of summer and winter travel peaks.

Other Mergers Seen

The study noted that approval of the merger might cause an acceleration of consolidation proposals among remaining carriers, and observed that "if the Board should approve this marriage of mammoths, it is hard to see how the Board could reject, other, more modest merger proposals."

Faced with stronger competition and heavy past losses, TWA might also attempt to merge with another large carrier. In turn, the study noted, CAB's regulatory workload might be greatly enlarged because of the loss of individual airline incentive to produce more attractive and competitive services.

The study called attention to the high percentage of loans obtained by the two airlines from a few major insurance companies and banks, and posed the question of "what prompted a proposal [merger] so novel?" It concluded that the merger talks and plans were instigated and handled by the representatives of these financial interests, who are also officers of the airlines involved.

A majority of the money loaned the "Big Four" airlines has been provided by the Equitable Life Assurance Society, Metropolitan Life Insurance, Prudential Life Insurance Co., and the Chase Manhattan Bank, the study said, and emphasized that these lenders have "acquired a colossal stake in the future of the airline industry."

Tracing a series of loan agreements between these lenders and American and Eastern since 1954, the study noted that of $290 million in long-term financing acquired by American, $55 million was obtained from Equitable, $170 million from Metropolitan and $75 million from Prudential. In the same period, Eastern signed credit agreements totaling $232 million, of which $90 million was supplied by Equitable, $72.75 million from Prudential and $28 million from Chase Manhattan.

Both American and Eastern have issued convertible debentures which, upon conversion to stock, would give Prudential about 16% of the outstanding common stock of Eastern and 6% of the outstanding common stock of American, while Equitable would obtain 6% of the common stock of American. "Thus these two major lenders together would be able to obtain working control of both parties to the proposed merger," the study said.

Many of the loan agreements in existence contain restrictions on mergers and in some cases specific lenders have the power to veto a proposed merger, the subcommittee study said. Other loan agreement restrictions are so severe as they subject a great deal of management decision directly to lender approval, it said.

Although conversion of the debenture holdings by the lenders could give them a high percentage of ownership this purchase option is not required to be reported to the CAB under present economic regulations, the report stated.

The interlocking directorships and relations between the carriers and lenders should also be closely examined by the Board, the study said, since they could provide an opportunity for the lenders to exercise their influence.

"Indeed, persons closely related to the lenders acted for American and Eastern in suggesting and negotiating the merger now proposed," the staff said.

Illustrating these relationships, the study noted that while the merger proposal to Eastern was made at the request of C R Smith, American's president and a Chase director, it was broached through Manly Fleischmann, who is not only a director of American but of Equitable as well. Fleischmann negotiated with Laurance Rockefeller, Eastern's largest single stockholder, the brother of David Rockefeller who is a director of Equitable and a president and chairman of the executive committee of the Chase Manhattan Bank. Talks were continued with these parties, along with Harper Woodward, Laurance Rockefeller's representative on the Eastern board.

"Equitable loaned American approximately $55 million, and Eastern approximately $90 million. Chase loaned Eastern approximately $28 million. Thus the merger was proposed and largely negotiated by persons closely affiliated with these two major lenders," the study said.

Other interlocking relationships exist between various combinations of airlines and lenders, the study said.

Among them, Juan Trippe president of Pan American World Airways, is on the board of Metropolitan. James Rockefeller a director of Pan American, is also chairman of the First National City Bank, one of the major lenders in the airline financing field.

Supersonic Transport Agreement Reached

London—Britain and France have agreed on principles which would govern an Anglo-French Mach 2.2 supersonic transport program, first reported by Aviation Week (AW Nov 6, p 40), but are hedging on a firm agreement to go ahead with the project.

Both nations authorized further design work on the transport here last week after a meeting between Minister of Aviation Peter Thorneycroft and Robert Buron, French minister of public works and transport. In effect, the ministers are keeping the pot boiling until later this summer, when the design study should be completed. The joint study is aimed at developing a program which Thorneycroft said will be used to aid the two governments in reaching a final decision.

The BAC team, headed by Dr. A. E. Russell of Bristol Aircraft, has designed in cooperation with Sud Aviation a slim delta configuration, powered by four rear-mounted jets. The airplane, which will be built in two versions—the French want a short-to-medium-haul airplane, and the British a long-haul aircraft for the North Atlantic and Commonwealth routes—will carry about 100 passengers.

Powerplants under consideration are the Bristol Siddeley Olympus 593, a Rolls-Royce supersonic engine still on paper, and a version of the Pratt & Whitney J75 (AW Feb 5, p 36). The Olympus, under development for the TSR.2 strike fighter, is currently gaining flight time in a Royal Air Force Vulcan testbed.

Gruening Criticizes CAB Probe Of Alaska Airline Subsidy Need

By Ward Wright

Washington—Sen Ernest Gruening (D Alaska) last week criticized the Civil Aeronautics Board on the Senate floor for its Pacific Northwest-Alaska Air Service Investigation which is aimed at reducing skyrocketing subsidy costs of two Alaskan carriers flying between that state and the U S mainland—the term CAB uses for the 48 contiguous states.

CAB in an order initiating the expedited investigation last month, said it took the action because without the probe it holds little hope for future reduction in total subsidy for Alaska mainland operations. This market is currently served by two subsidized carriers Alaska Airlines and Pacific Northern Airlines and two nonsubsidized carriers Pan American and Northwest airlines.

Two Proposals

Giving its views at the outset of the investigation, CAB outlined two favored proposals for reducing total subsidy—a two-carrier system and a three-carrier system. The two carrier system would involve:

- **Merger of Alaska and Pacific Northern Airlines.** CAB said it conducted a series of informal meetings among Alaska mainland carriers which ended Aug 31. While the carriers agreed there were too many airlines in Alaska mainland market none could reach any voluntary agreements to curb the competition.

Accordingly CAB said it would give a merged Alaska Airlines Pacific Northern operation unrestricted operating authority from Seattle to the four key Alaskan markets—Juneau, Ketchikan Fairbanks and Anchorage.

- **Northwest Airlines'** Seattle Anchorage flights would possibly be limited to those originating or terminating in the Orient. However Northwest would keep its unrestricted New York Chicago-Minneapolis/St Paul Anchorage authority.
- **Pan American's** Alaska air service would be terminated thus providing additional traffic for the remaining carriers. Its service to Fairbanks would be suspended until 60 days after the outcome of the reopened Transpacific Route Case—in which Pan American is seeking New York Tokio authority via Fairbanks. If this route is approved Pan American would serve Fairbanks only as an incident to its East Coast-Orient service.

CAB said the two-carrier plan should result in a subsidy free operation, but it noted that it was unable to compel the carriers to merge. If the two Alaskan carriers do not choose to merge, CAB suggested this three carrier plan as a possible solution.

- **Alaska and Pacific Northern Airlines'** route structure would remain essentially the same—with the exception that one or the other, or both would get Seattle Ketchikan-Juneau authority, as determined in the investigation. Both carriers currently serve Anchorage Pacific Northern via Ketchikan and Juneau, and Alaska Airlines via Fairbanks.

Portland Ore would be eliminated from both carriers' routes and for the first time, both carriers would be brought under CAB's economic regulations governing off-route charters.

Filings for intra Alaskan service between the four major Alaskan markets would be received in the investigation. CAB's study of the Alaska-mainland situation did not contain suggestions for possible new service patterns between these intra Alaskan points.

- **Northwest's authority** would continue subject to the same limitations outlined in the two carrier proposal. Pan American's Alaskan authority would be terminated also subject to the same conditions as outlined in the two-carrier proposal.

Earlier Probe

CAB said the present Pacific Northwest-Alaska investigation is an outgrowth of a similar one begun in January, 1958 and postponed by congressional action on Aug 14, 1958. Then, as now, CAB was concerned with the economics of the four-carrier Alaska mainland market and its need for subsidy. When a Senate resolution calling for postponement of the investigation was adopted, it was felt that more experience was needed with a 1957 law granting permanent certification to the U S Alaskan carriers. Also it was felt that statehood, once achieved, would have an effect on the economics of the operation. In 1959 the investigation was dismissed.

Since then CAB said there has been no improvement in the subsidy picture. In 1961 the two subsidized carriers needed $2 8 million for Alaska-mainland—about $500 000 more than in 1958. At the same time Pan American's Alaska division has suffered losses ranging from $2 million to $952 000 in 1960 since it went off subsidy in 1957. Pan American's Alaska losses for 1961 total $1 million.

Sen Gruening backed by a strong protest from the Alaska state legislature, criticized the CAB proposals as "an inexcusable piece of folly" and a return

to the 'double standards" that existed under the Eisenhower Administration

Cruening said the CAB proposals were made with the "avowed objective of eliminating, curtailing and consolidating the excellent Alaska-States air service.' He said the proposals, if adopted would replace "a good competitive setup with a monopoly with all the ills of a monopoly."

Cruening told the Senate that for various reasons Alaska has been deprived of much federal support for railroad, highway and shipping communications, while paying taxes to support similar programs in the 48 states. These factors make Alaska peculiarly dependent on air transportation he said. Until the state can develop alternative means of transportation, the penalty for years of neglect will be the need for airline subsidy, Cruening said.

Sen. Cruening cited as an example of 'double standards" an expenditure of $417 million since 1955 for helping other nations develop their air transport systems. In contrast, 1961 subsidy and mail pay for the two Alaskan carriers totaled $4.3 million—a small amount compared with the value of maintaining effective communication with the 48 states and within Alaska, Cruening said.

Group Shuttle Fares Filed by Eastern

New York—Eastern Air Lines last week filed for group fares in its air shuttle services between New York and Boston, New York and Washington and Boston and Washington. Under the plan, individual fares in groups of 40 or more would be $9 New York-Boston, $11 New York-Washington, and $19 Boston-Washington, reductions of $4, $4 and $8 respectively.

Among the business Eastern hopes to attract under the group plan are Visit USA groups and groups that travel to Washington on weekends in particular. The Visit USA customers are the primary target, since they usually travel in groups usually arrive in New York and normally wish to visit Washington.

Recent figures released by Eastern on its shuttle services indicate an increase of 52% in total air traffic between the three cities during the first two months of 1962 over the same months of last year. The 1962 total is 380,000, of which Eastern said it carried more than 65%. Eastern's shuttle had not been inaugurated during the 1961 period.

According to the carrier's figures, its own traffic—242,000 passengers for the two months—represents a threefold increase. Of the Eastern total, 70% used the shuttle service. About half of all air traffic between the three cities was shuttle passengers.

Proposed Bill, White House Study Add to U.S. Air Policy Confusion

By L. L. Doty

Washington—Legislation that could commit the U.S. to a fixed policy in international air transportation is being proposed at the same time a wide scale research study is underway to furnish the White House a guide in the development of such policy.

The interim report on the study, which is being conducted by private consultants under contract to the Bureau of the Budget, is slated for delivery to President Kennedy by mid-July, followed by a final report in mid-August. According to one of the two study groups, the project is moving on schedule.

Meanwhile, the congressional legislation, coupled with several Civil Aeronautics Board investigations in the international field, is being pushed without any reference to the study. The real muddle, in addition to the obvious one that will result from two branches of the government working toward a single goal without coordination, lies in the fact that some of the legislation, proposed to aid U.S. airlines in one area, is contradicted by action of the U.S. government in others.

Controversial Measure

Furthermore, much of the legislation represents a complete reversal of previous positions held by U.S. airlines but does not have the unanimous backing of the U.S. civil aviation community. Many of the dissidents feel that the new legislation if passed by Congress, could backfire abroad with serious repercussions that may weaken the competitive position of U.S. international airlines.

Here is a summary of action now being proposed:

- **Companion bills** have been introduced in the House and Senate which would authorize the CAB to require foreign flag carriers to file flight schedules with that agency for approval. In supporting the legislation, Stuart G. Tipton president of the Air Transport Assn., said the bill "would leave to the government's discretion whether a foreign air carrier's schedules or proposed schedules are in the public interest and in consonance with the applicable bilateral agreement. Purpose of the measure is to give the U.S. government some control over the capacity provided by foreign flag carriers serving U.S. ports.
- **Both House and Senate** have received bills that would empower the CAB to suspend a proposed or existing tariff related to foreign air transportation for a period not exceeding 365 days when such tariff appears to conflict with the public interest. In the past, airlines have violently opposed such legislation on grounds that the Board already held such authority. The CAB has fought consistently for this legislation but, in the words of Board Chairman Alan S. Boyd, "we have been turned down with depressing regularity." Purpose of this legislation is to give the Board power to eliminate rate cutting practices of some foreign airlines.
- **CAB** is currently conducting an investigation to determine whether foreign air carrier permits should be amended to require the filing of traffic statistics with the U.S. The purpose of this program is to develop a device that will permit the U.S. to decide whether foreign airlines are handling an excessive volume of Fifth Freedom traffic—passengers traveling from one country through a second and beyond to a third.
- **Route structure of U.S.** carriers in South America will probably be reshaped as a result of a current CAB investigation on Latin American route structures. A similar investigation of North Atlantic routes is expected in the near future. There is growing speculation in aviation circles here that the U.S. is headed for a "chosen instrument" policy on a regional basis—allocation of international routes to a single U.S. carrier to eliminate direct competition between U.S. airlines throughout the world.

U.S. airlines have been suffering from competition stemming from some foreign airlines, particularly in South America, who are not members of the International Air Transport Assn., and who, as a result, offer fares below the IATA tariff level.

Airlines' View

The airlines have theorized in the past that the CAB has the power to force such carriers to abide by IATA standards by placing tariff conditions in foreign air carrier permits issued to foreign flag carriers. Since they also reasoned that the Board has no power to impose similar conditions on their own certificates, the U.S. airlines opposed any legislation, such as that now proposed, that would include them as well as foreign flag airlines.

The CAB held an opposite opinion. It argued that the only means of attaining authority to fix and regulate foreign tariffs was through an amendment to the Federal Aviation Act that would specifically grant it such power. Presumably, the airlines, although still opposed to the measure, succumbed to the Board's views as the only means of bringing price-cutting to a halt.

If the legislation, once passed, is successful in eliminating the cut rate practice in South America, it will create at least one delicate problem for the U.S. in the North Atlantic area, since the ever-present issue of discrimination will require the Board to apply its new authority in all regions.

Icelandic Airlines is not a member of IATA. It survives on fares that are substantially lower than IATA standards. And its major route is the North Atlantic, to and from the New York gateway, where it steadily maintains a high load factor.

Until recently, Icelanders were opposed to the location of a NATO base on their land. Lately, they have noticeably dropped this opposition but it is unlikely that the State Department will want to risk disturbing this new relationship by forcing the country's flag carrier to raise its passenger rates above a level it considers profitable.

This is but one example of the problems the U.S. faces in the coordination of foreign policy matters with civil aviation issues. The issue of capacity has already sounded a sour note in U.S. relations with several European countries. On at least one occasion it has forced the U.S. to contradict its stated position that bilateral agreements give it the right to control capacity provided by foreign carriers serving the U.S.

At the recent Third Regional Conference of Civil Aviation in Bogota, Colombia, the U.S. delegation voted against a recommendation that traffic statistics be exchanged between the countries involved.

In the same conference, the U.S. delegation had this to say on traffic restrictions in South America:

"Although the United States delegation supports the gradual elimination of restrictions . . . it feels they should not be imposed in the first place . . . the U.S. delegation considers it necessary to let the capacity provisions of the bilateral agreements to which the U.S. is a party speak for themselves.'

Thus, as if to undermine its entire philosophy on capacity control in other areas—particularly Europe—the delegation added:

"Despite these objections the delegation of the United States welcomes the tendency toward liberalization evident in this recommendation and feels that as this tendency develops it will provide such dividends not only in the form of health, airlines in the area and improved service for the public but also in the form of expanded tourist industry."

General Dynamics Jet Write-offs Boost 1961 Loss to $143 Million

General Dynamics Corp. in writing off $214.5 million in jet transport costs which it estimates will be the last in its 880/990 program ended 1961 as a result with a $143.2 million deficit.

The losses were increased by a decline in operating income before deduction of jet program losses from $105.4 in 1960 to $46.4 million last year. Write-offs of losses on electronics operations and of anticipated losses on advanced programs caused part of this decline. Phase out of the F-106 interceptor and decline in B-58 Hustler bomber production, due to phase out by the fourth quarter of 1962, also contributed.

General Dynamics Electronics discontinued its high fidelity music systems programs which had shown losses. Military electronics projects also contributed to the write-offs. Though not unprofitable, the Electronics Division sold its intercom and paging systems lines which did not fit well into the over-all product mix.

Most of the 30 Convair 990s under firm contract will be delivered this year. Costs to complete the program are estimated at $119,400,000, and with $58 million in inventories on the books for the program produces a total of $177,400,000. General Dynamics estimates recoveries including unsold airplanes will match this figure. American Airlines terms specific, however, the 990 must be modified to reach guaranteed speeds or the 15 aircraft it is to receive will go back to General Dynamics.

American may take five more 990s if the airplane is brought to guaranteed speed but the five airplanes remaining of its original order for 25 are in the unsold category. Two originally destined for SAS also are unsold but the 13 ordered by Howard Hughes were in an early stage and will not be completed. Also unsold are the six 880M aircraft Capital Airlines ordered, two of which were leased by Swissair until delivery of its 990s but which will be returned.

American which expected delivery of its sixth 990 last week is not likely to make a decision on going beyond 15 airplanes until it sees a production airplane with the speed modifications.

Taking what it estimates as the last of the jet losses, plus cleaning up other loss situations in General Dynamics had a drastic effect on the company's balance sheet:

- **Working capital** fell to $49.7 million from $221 million the year before.
- **Earned surplus** of $119 million at the end of 1960 was wiped out and a $25 million deficit is left in this account.
- **Book value** per common stock share dropped from $16.95 at the end of 1960 to $2.09 last year.

Credit Agreement

Decline in working capital led General Dynamics to sign a two-year revolving credit agreement with banks during the year for a maximum of $200 million. Against this credit $155 million of 90-day short-term debt was due at year-end. To secure the $155 million debt, the company assigned $259 million in government accounts receivable, unreimbursed expenditures on government contracts and government inventories—a high proportion of what was available in these accounts.

Terms of General Dynamics $135 million long-term loan agreement with Prudential Life Insurance Co. were amended during the year and a restriction applied against payment of any cash dividends or any class of stock until $143 million in earnings are accumulated. This in effect means General Dynamics must restore its earned surplus account to pre-1961 levels.

Of the jet transport loss, $111,410,000 earned no benefit in carry-back tax credit thus increasing the 1961 deficit. However the corporation expects to realize tax credits of $57,933,000 by applying this loss figure to future earnings.

Amid the jet transport problems, total sales of the corporation set a new record and exceeded $2 billion for the first time, totaling $2,062,378,000 compared to $1,987,749,000 the year before. Net loss for 1960, during which jet program write-offs totaled $167 million, amounted to $27.1 million. Larger earnings from other programs and larger tax credits offset much of this loss.

Order backlog dropped to $1.7 billion from 1960's $2.5 billion to become the lowest backlog figure since 1957.

Supplementals' Bill

Washington—House and Senate conferees failed to agree last week on a compromise bill to give supplemental airlines permanent status. Central issue was the amount of individually ticketed authority which should be given to the supplementals, with Senate conferees arguing for their bill which authorizes the Civil Aeronautics Board to grant permanent operating authority under prescribed limitations (AW Feb. 26, p. 58). House conferees refused to tinker with their bill which provides only temporary operating authority. Although no future conference date was set, attempts to reach a compromise will resume soon.

La Guardia Runway Extension Planned

New York—Future of La Guardia Airport as an airline facility has become clearer with a Port of New York Authority announcement that plans are under way for runway extensions to permit handling of jet aircraft

The Port Authority has been uncommunicative on the subject of jet operations at La Guardia, but airline negotiations with the agency on possible runway extensions have been under way for some time Under a $65-million rehabilitation program now under way at the field, present runways have been rebuilt but only to a length of about 6,000 ft

The new plan would make possible operation of short and medium range jets as the Sud Caravelle Boeing 727 or BAC 111 But the field apparently will not be ready for these aircraft for another five and a half years Relocation of a ship channel will be necessary to make room for runway extension into the present Rikers Island channel The entire project, including extension of both runways to 7,000 ft , is estimated by the Port Authority to cost $25 million Instrument Runway 4-22 will be provided with a bi directional instrument approach system under the plan

Future jet operations would be subject to anti-noise procedures

Transport Purchase By Napier Approved

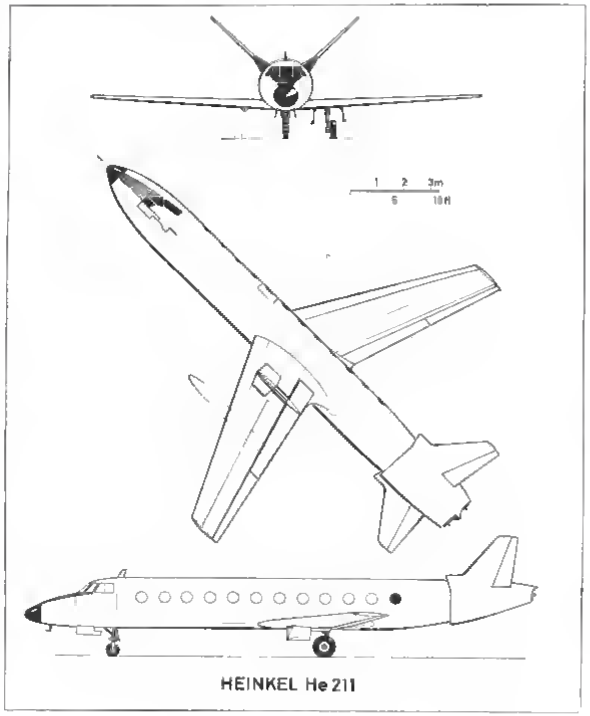
Washington—Civil Aeronautics Board has given tentative approval to Napier Aero Engines, Ltd 's plan to buy back Allegheny Airlines five Napier Eland turbine-powered Convair 540 aircraft for $5 4 million (AW Mar 12, p 321)

The move allows Allegheny to meet a $500 000 commitment for the purchase of two replacement piston powered Convair 440 aircraft with a short term bank loan The bank had conditioned the loan on tentative CAB approval which will allow Napier's payments to be used for collateral Allegheny has contracted to buy three more Convair 440s from Braniff Airways to be delivered later this year (AW Mar 26, p 31)

Terms of the agreement call for Napier to buy back the five 540s related spare parts and ground equipment for $5 4 million Payment will be in the form of five equal installments of $1 08 million In each of these, $400,561 will be in cash and the balance to be applied toward the release of Allegheny's promissory notes held by Napier CAB has given interested parties until the end of this week to file comments or request a hearing

Heinkel Proposes Short-Ronge Tronsport

New Heinkel proposal for a DC-3 replacement short range jet transport would be powered by two 4 200-lb thrust General Electric CF700 2B turbofan engines installed in parallel in the tail section of the fuselage between the butterfly tail. Tail section is similar to that of the Fouga Magister trainer, a project with which the German firm has been associated. Annular engine intakes can be seen in picture above Designed to carry 23 passengers over 700 mi stage lengths, and designated the HE 211, the aircraft has a cruising speed of 540 mph Maximum gross weight is 24,250 lb Heinkel reportedly hopes to obtain a financial, marketing and production partner within the U. S. if sufficient airline interest is shown. An earlier HE 211 proposal drafted in 1958 was powered by three GE J85 turbojets, one on either side of the rear fuselage the third buried in the tail section If it reaches production the aircraft will be West German industry's first jet transport



HEINKEL He 211

First Phase of 707 Crash Hearings Ends

By Glenn Garrison

New York—First phase of the Civil Aeronautics Board hearing into the Mar. 1 crash of an American Airlines 707 123B ended without revealing any clues as to what caused the Los Angeles bound flight to roll on its back and dive into a channel of Jamaica Bay after take off from Idlewild Airport

The four day hearing ended Mar. 23, and will be followed by a second public hearing at a time yet unscheduled Since only about two and a half weeks elapsed between the crash and the beginning of the hearing considerable data remained to be accumulated and presented at the second part of the hearing For example, two groups of investigators—the systems group and the structures group—reported their work in progress and promised detailed final reports at the next sessions (AW Mar 26, p 30)

Among several areas of investigation that received particular attention during the hearing was the possible effect of malfunction of components of the 707's flight control system, including stuck spoiler conditions It was brought out that a stuck spoiler incident occured about 1½ years ago on an American training flight at Los Angeles In this case, during an approach using speed brakes, one spoiler remained in the down position and one in the up position Attempting to turn left, the pilot found himself turning right However, he regained control Subsequently a modification was developed to replace two outboard spoiler bypass valves with a single valve to reduce the possibility of a one up and one down spoiler condition This modification had been made to the crashed airplane

It also was learned though not brought up at the hearing that a Pan American 707 departing London Feb 25 had spoiler trouble and returned to the airport The condition was a trailing spoiler, with the left inboard spoiler failing to retract. The flight was bound for New York with about 100 passengers aboard. The aircraft ultimately was ferried to New York

Possibility of electrical fire was also explored CAB was checking closely any possible relationship between the American accident and a recent incident in which a United 720 made an emergency landing at Tinker AFB because of a fire which filled the cockpit with smoke Work on the American jet, on its layover before the fatal flight, included a transformer change after mechanics discovered a circuit breaker on the flight engineer's panel kept popping out when a background light rheostat was operated When the old transformer was removed, a puff of smoke was observed

Complete electrical failure, it was testified, would result in loss of the inboard spoilers But a Boeing expert testified that loss of inboard spoilers during a bank would result in a loss of 20% of roll rate when coming back out of the roll and that the pilot probably wouldn t be able to tell the difference

The test pilot Donald Knutsen, who is chief of experimental test flight for Boeing said the 707 aircraft are controllable under any known split condition of control components to the best of his knowledge

Knutsen was questioned about the aircraft's reactions in stall buffet and recovery, stalls during turns, and rudder boost on and off conditions

Rudder Forces

Regarding rudder forces, he said a pilot s strength could overcome a hard over rudder signal without deboost Concerning roll tendency in turns the test pilot said that in an imperfectly coordinated turn there would be a tendency to roll in the direction of yaw, but this could be corrected with lateral control

If the inboard spoilers were deactivated during a left turn with flaps up and outboard ailerons locked out and then the inboard spoilers were activated, control would not be lost Knutsen said

Another witness T F Copeland, American's director of flying training, described the airline's jet training program Less emphasis now is placed on Dutch roll recovery, he said

One training maneuver involves deactivation of first inboard and then outboard spoilers and Copeland was asked if there had been any stuck spoiler situations resulting He said a training flight landing at Idlewild encountered a situation where one speed brake sprang up and the other stayed down resulting in a yaw

Questioned about the anti noise takeoff procedures for Runway 31L at Idlewild which call for a turn to 290 deg shortly after takeoff, Copeland said the requirements did not overtax pilot proficiency If there were no noise or ATC restrictions to consider, however, his technique for a New York-Los Angeles flight he said would be to continue on runway heading after liftoff until his airplane was at V_2 speed plus 50 kt , and then simply turn in the direction of Los Angeles

Several witnesses, including traffic control personnel on duty at the time of the crash, testified that they saw the plane dive into the channel with a resultant splash, but that no smoke appeared until several minutes after the crash

The 123B's takeoff gross weight was estimated at 247 038 lb., compared with a maximum takeoff gross of 257 000 lb In addition to the crew of eight there were 27 first class and 60 coach passengers a total of 95 persons all of whom were killed At 10 06 52 a m the flight advised it was rolling on the runway Its last known transmission was received at 10 08 8 At 10 08 23 the tower received a brief unmodulated signal with no intelligence At 10 08 55 seismographic stations in the area recorded a ground disturbance and it was estimated that 6 sec would be required for transmission of the disturbance from the aircraft impact site to the stations

Sectionalized Engine Overhaul Tests Set

Washington—Experimental program to determine whether sectionalized overhaul can extend the useful life of a turboprop engine is being undertaken by Eastern Air Lines and Allison Division of General Motors Corp with Federal Aviation Agency approval

Known as Project Telescope, the program's first phase will involve operating six Allison 501-D13 turboprops to their currently authorized time between overhaul (TBO) of 2,200 hr When this time is reached, Eastern will remove and overhaul only the engines hot, or turbine, section

Balance of the powerplant will remain on the wing of Eastern's Lockheed Electra After inspection a new or overhauled hot section will be installed and the turboprop operated for another 400 hr When each engine accumulates 2 600 hr., it will be analyzed by a panel of engineers from Eastern Allison and FAA

If these overtime engines are judged reliable at this point six other engines will be operated 800 hr beyond their current TBO and the analysis repeated Should these engines appear sound, a third phase involving a 1,200 hr hot section extension may be conducted

A similar sectionalized overhaul program for the General Electric CJ805 turbojet used on the Convair 880 was devised by GE and Delta Air Lines late in 1959 Delta started 880 service in May, 1960 used the concept briefly, then discarded it after finding it could escalate the CJ805's initial TBOs more rapidly under FAA's turbine engine time control program Air Force still uses sectionalized overhaul on some Pratt & Whitney turbojets

SHORTLINES

▶ **Aerolineas Argentinas** has ordered a de Havilland Comet 4C jet transport for delivery in the next two months. The order puts Comet sales at 67.

▶ **Bid by Aviateca**, Guatemalan airlines, to serve New York has been rejected by a Civil Aeronautics Board examiner in his recommended decision. Extension of the airline's service to New Orleans and Miami for three years was recommended. Final decision must be made by the Board.

▶ **Central African Airways'** Chairman R. M. Taylor said in Durban, South Africa recently, that his airline intends to buy three BAC 111 short haul jet aircraft for use on its Salisbury, Rhodesia-Johannesburg-Durban route. The aircraft will replace Viscounts about 1965.

▶ **KLM, Royal Dutch Airlines**, has bought a Douglas DC-8 with Pratt & Whitney JT3D-3 turbofan engines and incorporating an extended wing leading edge. Delivery is set for June.

▶ **Continental Air Lines** expects its four new Boeing 720B transports scheduled for delivery this spring to increase its pure jet capacity by 50%. The new 720s will allow Continental to begin jet service between Dallas-Ft. Paso and between Denver-Albuquerque July 15.

▶ **Northwest Airlines** will begin daily round trip service with DC-8 equipment on its polar route between New York and Tokyo via Anchorage on Apr. 29. Present service on this route is three round trips weekly.

▶ **Panama Aeronautica** has become the 15th Latin American carrier to join the International Air Transport Assn. Panama flies scheduled service between Panama City, Panama and Miami.

▶ **Trans World Airlines** estimates it will carry more than 25,000 group fare passengers (AW Mar. 19, p. 42) this year—including 10,000 passengers who would not have traveled overseas without the reduced fare plan.

▶ **West German Ministry** of Civil Aviation's 35% increase in landing fees at 10 major airports has brought vehement protests from the 38 International Air Transport Assn. airlines which serve the country. The new fees, imposed after 15 days' notice, increase the cost of landing a large jet from $199 to $269 and a Viscount from $42 to $57.

AIRLINE OBSERVER

▶ Federal Aviation Agency, in charge of U.S. civil supersonic transport development, had hoped to obtain important data on nuisance implications of the sonic boom from the Mar. 5 transcontinental speed dash of a Convair B-58A (AW Mar. 12, p. 313). But according to FAA sources, when Strategic Air Command refused to cooperate with the Agency on such items as route and altitude planning, FAA withdrew from the project. The much publicized flight produced more than 600 sonic boom complaints, but FAA officials noted that the B-58A generally flew at altitudes under 55,000 ft. over a track plotted for minimum time en route rather than noise abatement. Meanwhile, FAA will propose that the first supersonic transport be operated in cargo service for an extensive period before being placed in passenger service.

▶ **Airline operators of the Douglas DC-8 and Lockheed Electra transports are studying the possibility of a parts pooling program. Seven carriers—American, Braniff, Eastern, United, Western, TWA and Pan American—will begin pooling of 315 basic Boeing jet parts at 34 airports later this month. About $605,000 worth of Boeing parts are involved in initial pooling which will substantially reduce individual inventory costs.**

▶ Passenger traffic on North Atlantic scheduled routes increased 17.7% in February over the same month last year. However, available seat miles during February rose 25.9% to force load factors down to 54.4%, 3.2% below that of the previous February.

▶ **Chicago's Midway Airport, historically the nation's busiest, ranked 12th in total number of aircraft landings and takeoffs in 1961. Los Angeles International Airport moved into first place last year followed closely by Chicago's O'Hare. Miami was third trailed by Washington National, New York International (Idlewild), Tamiami, Phoenix, Van Nuys, Long Beach, Denver and Honolulu International. Decline of Midway from first to 12th in a single year is due to short runways, which prevent its use by jet transports, which are accommodated at O'Hare.**

▶ Commerce Department study of aircraft market potential in certain Asian and southwest Pacific countries indicates that demand for used, long range, piston engine transport aircraft is severely limited because of growing preference by regional airlines for modern, short-range turbine-powered equipment. The report suggests, however, that U.S. will have stiffer sales competition in these areas from foreign manufacturers because of high costs of new U.S. aircraft. Best markets for aircraft currently in production are New Zealand and Australia (AW Nov. 27, p. 46), but these do not fit the needs of most other countries surveyed.

▶ **Western airlines flying into Berlin through the three air corridors over East Germany are experiencing increased load factors despite Soviet threats and intimidation. On one route segment, load factors are 25-30% higher than at this time last year.**

▶ Aeroflot is attempting to lure non-Communist traffic to its new Moscow-Djakarta service. The Russian carrier has sponsored English and French language advertisements calling on air travelers to "avail themselves of the unique opportunity to cross the equator in an IL-18!" The ads say that Aeroflot "has linked Europe and Asia by the shortest possible route—covering the 10,000 kilometer Moscow-Djakarta run in 24 hours with only three stops: Tashkent, Delhi and Rangoon."

▶ **Thai Airways International is scheduled to operate on an interchange basis the Convair 990 Coronado medium-range jet transports on lease from Scandinavian Airlines System when the aircraft go into service in May. SAS will use the aircraft on two weekly flights to Tokyo where the airplanes will be taken over by Thai for the round-trip service from Tokyo to Taipei, Bangkok, Singapore, Djakarta and back to Tokyo.**

▶ United Air Lines is modifying wing leading edges on its three turbofan-powered Douglas DC-8s by increasing chord length approximately 4%. Extension will lengthen chord by 6½ in. at wing base, tapering down to a 3 in. increase at wing tip.

U. S. Airline Traffic Growth—1961 over 1960

	REVENUE PASSENGERS				REVENUE TON MILES (000)			
	1960	1961	Increase or (Decrease) Amount	Per Cent	1960	1961	Increase or (Decrease) Amount	Per Cent
Trunks								
American	8,102,782	7,612,365	(490,417)	(6)	751,283	734,676	(16,607)	(2)
Braniff	2,232,946	2,247,928	14,982	1	116,807	121,036	4,229	4
Continental	1,336,794	1,336,855	61	0	94,327	98,534	4,207	4
Delta	3,358,907	3,646,840	287,933	9	201,944	241,681	39,737	20
Eastern	7,634,356	7,758,683	124,327	2	433,292	436,562	3,270	1
National	1,640,160	1,652,271	12,111	1	114,081	127,315	13,234	12
Northeast	1,439,438	1,647,164	207,726	14	58,909	77,921	19,012	32
Northwest	1,847,953	1,444,204	(403,749)	(22)	158,414	118,729	(39,685)	(25)
Trans World	4,967,334	4,693,547	(273,787)	(6)	502,055	497,490	(4,565)	(1)
United/Capital	11,164,532	11,360,856	196,324	2	801,149	889,118	87,969	11
Western	1,668,233	1,475,275	(192,958)	(12)	100,222	92,156	(8,066)	(8)
Total	45,393,435	44,875,988	(517,447)	(1)	3,332,483	3,435,218	102,735	3
Local Service								
American	110,051	86,201	(23,850)	(22)	14,794	13,180	(1,614)	(11)
Braniff	65,413	111,458	46,045	70	15,860	19,961	4,101	26
Caribair	377,423	439,701	62,278	17	2,819	3,053	234	8
Delta	27,610	17,056	(10,554)	(38)	4,584	2,443	(2,141)	(47)
Eastern	491,811	506,927	15,116	3	75,808	76,761	953	1
Mackey	128,176	122,822	(5,354)	(4)	2,886	2,240	(646)	(22)
National	32,652	3,603	(29,049)	(89)	3,002	211	(2,791)	(93)
Northwest	185,296	197,559	12,263	7	61,492	68,273	6,781	11
Panagra	124,594	130,565	5,971	5	29,187	33,991	4,804	16
Pan American	3,184,711	3,508,861	322,150	10	718,769	883,548	164,779	23
Samoan	5,827		(5,827)	(100)	60		(60)	(100)
South Pacific	1,742	2,470	728	42	510	715	205	40
Trans Caribbean	139,863	108,764	(31,101)	(22)	23,129	17,356	(5,773)	(25)
Trans World	382,916	302,066	(80,850)	(21)	136,077	142,319	(13,758)	(9)
United	162,804	185,232	22,428	14	45,623	53,556	7,933	17
Western	53,386	53,862	476	1	9,093	9,076	(17)	(0)
Total	5,474,277	5,775,467	301,190	6	1,163,693	1,326,683	162,990	14
Local Service								
Allegheny	670,111	827,274	157,163	23	13,655	18,126	4,471	33
Bonanza	261,876	316,559	54,683	21	6,498	7,961	1,463	23
Central	168,863	243,847	74,984	44	3,456	5,125	1,669	48
Frontier	338,189	358,138	19,949	6	9,886	10,699	813	8
Lake Central	226,936	399,077	172,141	76	3,735	6,725	2,990	80
Mohawk	590,162	789,004	198,842	34	12,006	16,532	4,526	38
North Central	967,210	1,010,508	43,298	4	18,206	19,999	1,793	10
Ozark	563,184	569,431	6,247	1	10,443	10,887	444	4
Pacific	499,393	448,078	(51,317)	(10)	11,307	10,380	(927)	(8)
Piedmont	457,123	498,913	41,790	9	9,880	10,844	964	10
Southern	256,947	392,776	135,829	53	4,953	7,604	2,651	54
Trans Texas	306,885	321,657	14,772	5	7,783	8,077	294	4
West Coast	389,077	379,171	(9,906)	(3)	9,364	9,469	105	1
Total	5,695,958	6,554,433	858,475	15	121,172	142,428	21,256	18
Helicopter								
Alaska Airlines	123,616	92,733	(30,883)	(25)	16,108	15,123	(985)	(6)
Alaska Coastal	59,089	57,460	(1,629)	(3)	723	711	(12)	(2)
Alohe	361,765	356,387	(5,378)	(1)	4,488	4,405	(83)	(2)
Cordova	16,771	24,474	7,703	46	960	897	(63)	(7)
Ellis	60,509	54,967	(5,542)	(9)	439	406	(33)	(7)
Hawaiian	518,989	483,111	(35,878)	(7)	13,254	8,110	(5,144)	(39)
Kodiak	537	11,858	11,321	—	3	92	89	—
Nor. Consolidated	29,121	31,609	2,488	9	2,241	2,647	406	18
Pacific Northern	120,713	130,186	9,473	8	16,963	20,619	3,656	22
Reeve Aleutian	16,231	15,790	(441)	(3)	3,128	3,525	397	13
Western Alaska	6,079	9,329	3,250	53	53	83	30	57
Wien Alaska	44,385	45,383	998	2	3,068	3,483	415	14
Total	1,357,805	1,313,287	(44,518)	(3)	61,428	60,181	(1,327)	(2)
Intra-State								
Chisago	309,769	245,506	(63,763)	(21)	511	422	(89)	(17)
Los Angeles	39,184	41,468	2,284	6	217	230	13	6
New York	146,775	149,846	3,071	2	326	317	(9)	3
Total	495,228	436,828	(58,408)	(12)	1,054	969	(85)	(8)
Non-Scheduled								
AAXICO	—	3,370	3,370	— —	35,758	26,803	(8,955)	(25)
Aerovias	—	—	—	— —	5,660	2,891	(2,769)	(49)
Avalon	59,935	81,104	21,169	35	249	378	129	52
Flying Tiger	42,709	47,474	4,765	11	121,543	159,879	38,336	32
Resort	—	—	—	—	19,974	—	(19,974)	(100)
Riddle	1,251	44,637	43,386	—	32,893	102,010	69,117	210
Seaboard	27,393	44,054	16,661	61	60,923	80,706	19,783	32
Slick	28,473	21,238	(7,235)	(25)	66,011	55,866	(10,145)	(15)
Total	159,759	241,877	82,118	51	343,011	428,533	85,522	25
INDUSTRY TOTAL	58,576,462	59,197,882	621,390	1	5,022,841	5,393,932	371,091	7

Braniff Predicts Increased 1962 Profit

New York—Braniff Airways made money in 1961—$1,274,757 including equipment sales and non-recurring tax adjustments—and expects better earnings in 1962 according to Charles E. Beard, Braniff president.

Beard said that January was profitable against an unprofitable January 1961, and that February, though showing a loss, was not nearly as unprofitable as February a year ago. March looked good the first 12 days, and even with February as a traditional loss month Beard said the first quarter of 1962 might result in a profit.

In January and February of this year, he said, revenue passenger miles were 11.7% and 10.6% ahead of last year, respectively.

Braniff is projecting 1962 increases of:

- Revenue passenger miles—13.5%
- Mail ton miles and express ton miles—8% each
- Freight ton miles—11%

"To say that the last two years have been difficult ones in which to make money in the airline business would be sort of a trite understatement," Beard told the New York Society of Security Analysts.

"At the time we arranged our long-term borrowings in 1955 and 1956 we stated with candor to the representatives of the institutions involved that we expected two difficult and probably even profitless years, not only for ourselves but for the industry. We felt the problems of excess capacity would hit our particular company in 1959 and 1960. We were wrong by a full year.

"1959 resulted in the third best profit year in Braniff's history, but 1960 and 1961 were genuinely difficult years. Unfortunately the capacity problems were augmented by a sagging economy in late 1960 and in 1961."

Even so, Braniff was able to show a profit both years and Beard was critical of the strong emphasis placed on heavy airline industry losses in 1961. "Such generalizations," he said, "provide no effective information to the investing public and serve no useful purpose of any kind."

Technically, he said, it is true the domestic trunklines showed a combined net loss of $37 million in 1961. (Air Transport Assn. has since revised this figure to $34 million.) Furthermore, the profit earned by most airlines in 1960 and 1961 was far from adequate as a return either on sales or invested capital. But, by interpreting the combined figures differently, these varied conclusions might be drawn with complete accuracy.

- Seven of the eleven trunk airlines had a combined net profit of $23 million.
- Big Four carriers combined lost more than $37 million, but the smaller seven lost only about $350,000.
- Two of the Big Four carriers lost money in 1961, but only two out of seven of the regional airlines did.

This is an interesting but rather mixed-up game, Beard asserted.

Braniff's 1961 profit included $612,509 in net earnings on sale of aircraft and $531,554 in credits following adjustments in previous years' income taxes. The credits involved a change permitted by CAB in handling tax reserves for aircraft under accelerated amortization.

Beard said the biggest struggle in 1961 was in cost control and capacity control. By frequent adjustment of schedules he said Braniff was able to hold available seat miles to a 9% increase—despite addition of three large jet aircraft—against a revenue passenger mile increase of 14%.

Through various sales activities including merchandising of jet aircraft cargo capacity that produced a $1 million increase in air freight revenues, Beard said, Braniff was able to reduce the cost of producing a revenue ton mile of traffic from 63.27 cents in 1960 to 61.63 cents in 1961. One facet of cost control is computer mechanization which reduced spare parts inventories during 1961 despite the addition of three Boeing 720 transports. Inventory increase since 1957 has been held to less than $100,000, Beard said.

Adding to operating revenues was a charter agreement with Gibson Refrigerator which carried 5,000 passengers and was responsible for most of a 50% increase to $1,983,977 in an account that was labeled "other operating revenues."

Beard also reported:

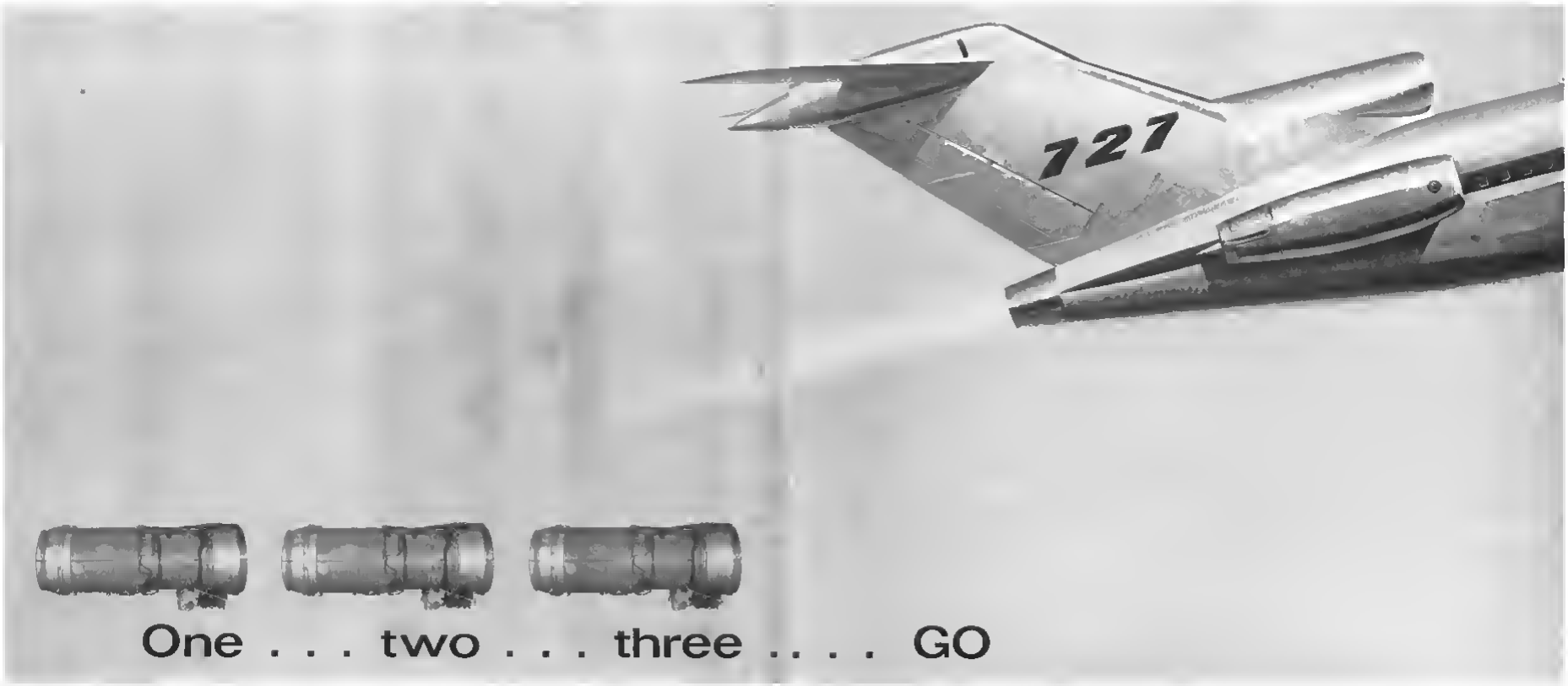
- First-class traffic revenues declined 12.7% from $53,605,000 in 1960 to $46,784,000 in 1961. As a percentage of passenger revenue total traffic it dropped to 59% from 68.5%.
- Coach passenger revenues rose 32.4% from $24,612,000 in 1960 to $32,577,000 in 1961. As a proportion of passenger revenue coach rose from 31.5% to 41%.
- International operations resulted in a $693,000 loss. Because of the South American rate war, non-stabilizing somewhat average revenue per revenue passenger mile for Braniff internationally fell from 7.189 cents in 1960 to 6.440 in 1961.
- Internally generated cash will pay for a fourth Boeing 720 to be delivered in May and for six BAC 111 short-range jet transports to be delivered in 1964 and 1965. Braniff's cash flow in 1963 from depreciation and amortization alone, assuming only breaking even on operations, is projected at $8.5 million, which exceeds its debt and interest payments by $3.3 million. This excess drops to $3.4 million in 1964 and is projected to increase substantially afterward.

Comparative Summary of Financial and Statistical Data

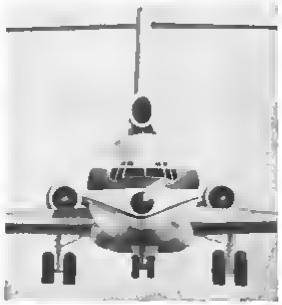
Braniff Airways, Inc.

	1958	1959	1960	1961
Total revenues	$46,798,650	$74,258,230	$86,550,701	$89,397,244
Total operating expenses	43,426,849	69,858,339	83,944,469	86,891,427
Net profit operations[1]	1,388,072	2,855,394	462,468	283,293
Net profit equipment sales[1]	288,326	457,987	258,092	459,918
Total net income	1,668,398	2,513,381	720,561	1,274,757[2]
Total investment (at Dec. 31)[3]	23,479,180	63,869,980	76,706,105	78,246,971
Net worth (at Dec. 31)	23,479,180	36,869,980	36,706,105	37,538,644
Book value per share	12.74	12.51	12.45	12.73
Cash from depreciation	$3,351,590	$6,235,811	$7,761,211	$7,722,796
Cash generated[4]	5,019,988	8,749,192	8,481,772	8,997,553
Cost per available ton mile	31.08¢	29.06¢	29.55¢	28.76¢
Cost per revenue ton mile	$8.85¢	59.53¢	63.27¢	61.63¢
Available seat miles (000)	1,161,333	1,784,565	2,096,948	2,116,581
Revenue passenger miles (000)	679,965	1,025,685	1,180,934	1,197,785
Interest paid	$179,981	$888,226	$1,677,243	$1,928,212
Long term debt (at Dec. 31)		27,000,000	40,000,000	40,708,333
Debt as a per cent to total investment		42.27%	52.15%	52.03%

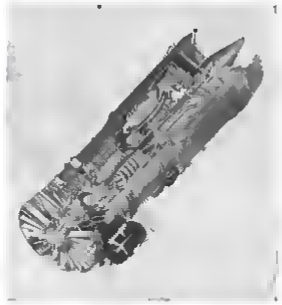
[1] After applicable taxes
[2] Net worth plus long term debt
[3] Includes income tax adjustment for prior years in amount of $531,544
[4] Net income plus depreciation



150 hour endurance run included 18 hours at takeoff power under hot day conditions; 45 hours at maximum continuous power. There were no shutdowns for engine problems.



Three aft mounted JT8D's will power the Boeing 727. This compact jet is designed for profitable operation over low-density routes with 150-to-1,700 mile stage lengths.



Turbofan JT8D features 13-stage compressor, 4-stage turbine. Compression ratio is 15.5:1. The 14,000-pound thrust design advances proven JT3 and JT4 features.

Pratt & Whitney Aircraft to deliver first JT8D turbofans for Boeing 727 flight tests

Sometime soon, three aft-mounted Pratt & Whitney Aircraft JT8D turbofan engines will power the Boeing 727 jetliner on its initial flight—little more than a year after the engine ran for the first time.

Such swift progress is possible because the JT8D's basic design has been proved by more than 20,000,000 JT3 and JT4 flight hours. Capitalizing on this experience, Pratt & Whitney Aircraft has developed a lightweight, high-efficiency powerplant with 14,000 pounds thrust. The JT8D achieves this advanced performance through a design concept already familiar to operating personnel at 36 world airlines.

With its trio of turbofans, the 727 can operate at full load from 5,000-foot runways. This 550-to-600 mph jetliner is designed for profitable operation over low-density routes with 150-to-1,700 mile stage lengths. To date, United Air Lines, Eastern Air Lines, American Airlines, Lufthansa, and Trans World Airlines have ordered a total of 127 planes. By 1963, the 727 will bring the benefits of jet travel to new cities throughout the world.

Pratt & Whitney Aircraft

U A

DIVISION OF UNITED AIRCRAFT CORP.

Apollo Reshapes NASA, Industry Roles

By Evert Clark

Washington—Vast undertaking of landing U S astronauts on the moon by 1970 is producing new management patterns and problems in the National Aeronautics and Space Administration They include

- **Much greater reliance** on industry for management help than NASA originally planned
- **Determination** by NASA headquarters to maintain tight control over the program, both within the agency and in its relationships with contractors
- **Open and increasing pressure** from congressmen for more of the $20 billion program to be spent in their areas
- **Increased attention** from congressional committees and the General Accounting Office of NASA's procurement methods

Last year saw the first important steps toward internal reorganization and the awarding of major contracts once the President and Congress had approved the accelerated and expanded lunar landing program

But the magnitude of the program apparently is only being fully grasped by both government and industry as it moves along

Management Aid

NASA has found that it must call on American Telephone & Telegraph and General Electric Co for management functions it once planned to fulfill itself, because the pressure of time and the limitations of government salaries did not allow the buildup of the large, highly-skilled staffs that would have been required

Contractors who have begun tackling the major hardware tasks involved in the launching vehicles and the spacecraft have, in many cases, found the need for manpower and facilities greater than either side had anticipated

Brainerd Holmes, in whose Office of Manned Space Flight the management of the Apollo program is centered, has called it "one of the most difficult technological and management undertakings with which man has been faced

"This is a program in which much of the industrial and university skills of the nation must take part," he told a congressional subcommittee "Indeed, it is to be expected that participation by Americans will exceed the 100,000 mark, participation by individual companies will be measured in the thousands, and participation by universities and research organizations will be numerous"

Increased Competition

This broad participation, and the Kennedy Administration's frank admission that it is using space dollars wherever possible to help strengthen the domestic economy, has encouraged congressmen to ask NASA bluntly for a greater share of space spending It also has sharply increased the competitiveness of space contracting and aroused the watchfulness of Congress and the General Accounting Office

Both the AT&T and the GE contracts were negotiated directly, without a formal competition NASA officials recently told a House Science and Astronautics subcommittee that approximately 49% of the space agency's dollars went for non competitive, negotiated contracts, 47% for competitive negotiated contracts, and 9% for fixed-price advertised contracts

While the subcommittee apparently accepted NASA's explanations of the need for the AT&T and GE contracts, it did so only after close questioning and after a thorough exploration of whether NASA could spread its contracting more widely through the 50 states

Management Structure

NASA's present management structure is a result of a number of studies by internal and external groups A year ago, an office of programs was established under D D Wyatt to allocate the agency's resources and perform a reliability and quality insurance function. In the past year, the office of administration under Albert F Siepert has placed increased emphasis on management analysis, chiefly through Siepert's deputy, John D Young and the director of the management analysis division, Walter A Hahn

Robert C Seamans, Jr, NASA's associate administrator or "general manager," told Congress that five or six plans were studied before it was decided that all technical centers and all headquarters program offices should report directly to him Among those consulted was Vice Adm William F Raborn, who then headed the widely praised management team directing development of Navy's Polaris fleet ballistic missile system

When Holmes' office was established it was given its own systems office, which is headed by Joseph F Shea, Holmes' deputy director The systems function for the other three main programs in NASA—space sciences, advanced research and technology and applications—is carried out at the technical center level rather than at headquarters.

"The manned space flight program is so all inclusive that we felt it necessary to have a large technical engineering and analysis group directly reporting into Mr Holmes," Seamans told the House subcommittee

Other internal organizational lines also have been re-drawn more clearly so that Marshall Space Flight Center at Huntsville, Ala, which does about 90% of its work for the manned program, the Manned Spacecraft Center at Houston, Tex, which is almost 100% oriented toward the manned program, and the new Launch Operations Center at Cape Canaveral, Fla, which will have manned flight as its biggest task, will report directly to Holmes (AW Mar 12, p 31)

Other NASA elements—Goddard Space Flight Center, Langley, Ames and Lewis Research centers, the Flight Research Center at Edwards, Calif, and the Jet Propulsion Laboratory—also will work directly with Holmes office on any project that supports manned space flight, although they will continue to report through other program offices for work unrelated to manned flight.

Seamans told AVIATION WEEK that the management structure chosen for Holmes office was necessary for "the fantastically large development" that the Apollo program requires

"We needed an office that gets into more of the technical ramifications that we have usually had in a headquarters office," Seamans said It has to have an over-all systems activity that can decide, 'What is the country trying to do in manned space flight?' Stations in orbit around the earth look interesting, for example We must keep a perspective on what we want to do

"We must carry out a series of conceptual designs and lay out a series of projects—Mercury, advanced Mercury, Gemini, Apollo We will certainly ride two horses for awhile, rendezvous and direct ascent, for Apollo, and we must look at the many permutations of those approaches

"We need to know how much to use the crew and their capabilities and how much to delegate to the ground We need the over-all view, but today—not later Shea must have top level people to work with him

"We would prefer to have this a totally in-house group but we could not get enough people in time, so we asked AT&T Shea will assign technical studies to AT&T, they will report back to him, but it will be Shea who makes the decisions"

Flexibility Sought

Both this and the GE contract illustrate the need to call in technical management help and NASA's desire to retain control NASA chose profit making companies Seamans said "because if you're wedded to a non profit organization there is not much you can do, but with a profit making firm you can change at any time"

"If the only reason for an organization to exist is one specific function, you're locked in You also get flexibility with a corporation of large dimensions It can expand or contract its group to suit your needs, and the whole prestige of its operation is at stake"

NASA is acutely aware of the criticism that Space Technology Laboratories, Inc, suffered from industry when it played the role of systems engineer and technical director for the former Air Force Ballistic Missile Division and of the current skepticism in Congress over the use of non-profit firms to handle government business

"We don't want either GE or AT&T in the role of telling the contractor what to do," Seamans said "They are obtaining information or carrying out data processing which will be used by government in making decisions."

Two other ways in which NASA is maintaining control are

- **New policy** that will require all large space vehicle stages to be built in government-owned facilities (AW Mar 19, p 25) These can be new plants or existing facilities that are now under Air Force or Navy cognizance, including those already at aerospace companies' main locations. NASA will have to supply the special tooling to build these large stages, and it wants the option of removing a contractor from a government plant and selecting a new contractor any time it is not satisfied with performance
- **Insisting** that a contractor selected

Spotlight on Reliability

Washington—No single element of the U S effort to land men on the moon by 1970 is receiving more emphasis right now than reliability National Aeronautics and Space Administration officials are stressing it internally in congressional testimony and in speeches to outside audiences

They have further demonstrated their concern with reliability by awarding General Electric Co a contract that may run eventually to more than a quarter of a billion dollars and that has as its primary goal the assurance that the vast undertaking of a manned lunar flight will be a success

Robert C Seamans, Jr NASA's associate administrator recently told a Cleveland audience:

"The reliability to be expected in the early flights of these vehicles used in our manned lunar landing program has an extremely important bearing on the time required to accomplish the mission and on the cost of the over-all program

"It might be said that the chances of going to the moon in this decade are slim indeed unless a significant step forward is taken in obtaining high reliability earlier in the life of vehicles than has been experienced to date

"These big space vehicles will be the first developed especially for manned space exploration. The unit cost will be high Only a few of each version will be produced. The systems and the missions are extremely complex, involving long periods of operation in space and a return launch from the moon without the help, needless to say, of a lunar Cape Canaveral

"It is a good thing to have the spotlight of public attention on reliability at this critical time If the challenge of the space age can help bring to this nation a more fervent desire to do the job right, at every level from top management to craftsmen to shipping clerk, in industry, government and the classroom, that may well be one of the major benefits we derive from our national investment in the new age

"We are engaged in a tremendous scientific and technological effort to carry out our accelerated national program After the brains, the skills and the industrial resources have been marshalled, the key to success still lies in reliability—the assurance that men and equipment will do what they are supposed to do at the right time and for the right period of time, in every phase of long and complicated operations"

Hybrid Rocket Engine Test Fired

One of a series of four experimental 10,000 lb thrust hybrid rocket engines is fired by United Technology Corp at its Morgan Hill, Calif development center. Hybrid engines were designed and fabricated under company funded program and have been fired for durations of 15 to 20 sec. Study includes investigation of scaling test engines for larger sizes and use of high energy propellants for upper stage missions

for management help either does not normally compete for manned spacecraft or booster hardware, as in the case of AT&T, or is excluded from other Apollo competitions. GE, for example, is the major supporter of Massachusetts Institute of Technology in MIT's development of an Apollo guidance system, but GE will not bid for production of the system or for any other Apollo prime contract.

GE Contract Details

When the selection of GE to assist James E. Sloan, Holmes director of integration and checkout, was announced last Feb. 9, it caused surprise and some confusion among other Apollo contractors. NASA had not made its intention to seek contractor aid for this function widely known and first interpretations were that GE was being given the systems integration job for the entire launch vehicle and spacecraft.

The last paragraph of NASA's announcement said:

"NASA selected GE for the job after considering a number of major corporations with space systems integration and checkout experience."

In recent hearings before the House space committee's Subcommittee Number One, chaired by Rep. Olin Teague (D.-Tex.), the following exchange took place between Rep. Emilio Q. Daddario (D.-Conn.) and Seamans and Holmes:

Daddario: Did you give any other contractors the opportunity to present a program so that they might have been considered as the managers of this particular section of your manned—

Seamans: Yes, we discussed this with other contractors.

Daddario: Which ones?

Seamans: Discussed the possibility with Ramo-Wooldridge.

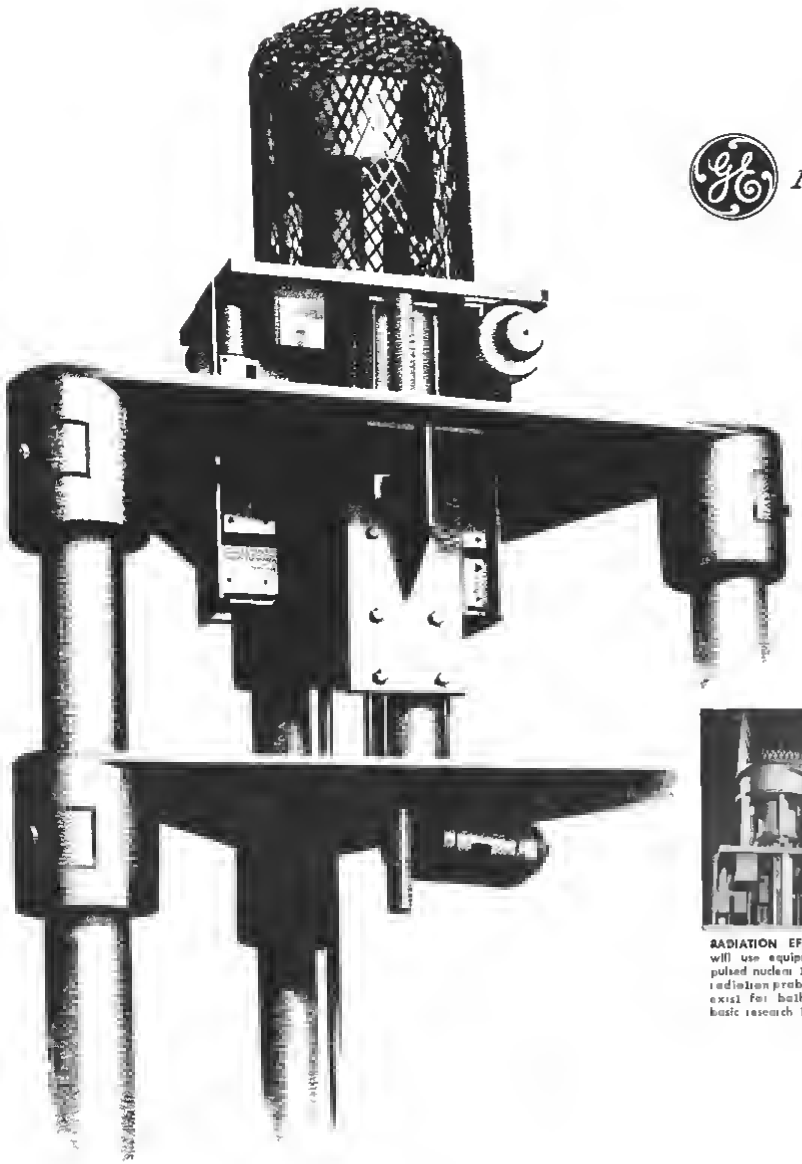
Daddario: Only Ramo Wooldridge?

Seamans: We had the most detailed discussions with them, yes.

Holmes: We did have the benefit that many bidders bid on Apollo, of which General Electric was one, and analyzed the data of these reports to some lengths including the discussions that went on before making a decision as to who we thought was best qualified at this time to take on that responsibility.

Daddario: Yes, but at that time the people didn't realize when they submitted their proposals there might be additional requirements for further management responsibilities and they might not have included within their proposals information which might have been of considerable advantage to you in your own plant?

Holmes: Well, that is partly true, although the Apollo procurement was broad enough. The command module of the spacecraft, the service module, it

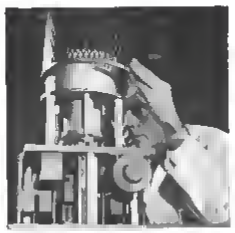


NEWS....OF DEFENSE TECHNOLOGIES

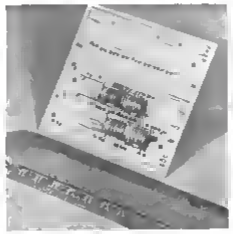
NUCLEONICS

The damaging effects of radiation from nuclear weapons and space have introduced a whole new class of problems in the design of electronic systems and support equipment. For example, gamma radiation ionizes air to provide leakage paths for stray currents. Conventional insulating materials become partial conductors. The performance of transistors and ferrites is altered and voltages are induced in coils, wires, and cables. Van Allen radiation darkens the windows of space vehicles and causes deterioration of semi-conductor materials, such as solar cells.

The creation of systems and equipment to function reliably in these environments requires special test facilities, skills, tools, and knowledge that have been developing at General Electric for more than twenty years. A newly organized Radiation Effects Operation is now integrating nuclear and electronic disciplines (nucleonics) and further developing the capabilities of the Company in this new field.



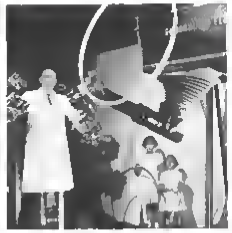
RADIATION EFFECTS OPERATION will use equipment such as this pulsed nuclear test reactor to solve radiation problems. Capabilities exist for both simulation and basic research in radiation effects.



HARDENED ELECTRONICS, such as this Thermionic Integrated Micro Module board, are being developed. TIMM circuits operate above 500°C and can tolerate 1000 times more radiation than conventional circuits.

NUCLEAR DETECTION SYSTEM (NUDETS-477L) is the first defense system combining nuclear and electronic technologies. It is being developed for U. S. Air Force to locate and measure any nuclear explosion in U. S.

SHIELDING OF SPACE VEHICLES from radiation may be possible by surrounding them with magnetic energy. This new concept, under study for NASA, may alleviate the need for heavier solid shielding.



ELECTRO-HYDRAULIC HANDYMAN is an example of remotely operated servo systems being produced to manipulate radioactive materials for routine tasks as well as highly specialized nuclear research projects.

Progress Is Our Most Important Product

GENERAL ELECTRIC

DEFENSE ELECTRONICS DIVISION

with part of the procurement so that within these proposals we could show you if we reviewed them with you there was demonstrated this capability of integration for checkout for the approach to checkout of those people who bid of which there is a large number if you take all the industries involved in the teams I feel they did demonstrate just these capabilities we are using with the General Electric Co

NASA's announcement of the GE contract said the first phase would be a study of approximately six months, requiring about 75 people and costing about $1 million

Holmes told Congress a month later that the study phase will run about eight or nine months and cost between $2 million and $2 5 million At that time, the work statement covering the study phase had not been completed, although General Electric had begun work on some tasks under the work statement

A very rough estimate of the number of technical people GE will need for the second, or implementation, phase of the contract is 600, Holmes told AVIATION WEEK.

Cost for technical and support personnel and for the building of checkout hardware not specifically called for in other Apollo contracts is expected to run to some $40 million to $50 million a year over the five or more years when GE's activity is at a peak Holmes said

The scope of GE's work will be defined partly by the current study, but essentially it is to help NASA decide whether the job is being done properly after AT&T has helped NASA decide what jobs should be done and how

Fewer Firings Sought

"We must know how to make the hardware truly reliable," Seamans said. "On the earlier vehicles, until you fire 40 or 50 you don't come close to the inherent reliability We feel there must be a way to make some drastic reduction in the number of firings In the integration and checkout function Sloan, with GE as his right arm, will first study the whole process on the kinds of tests that are needed at the contractors' plants, at the Mississippi Test Facility, at Cape Canaveral

"GE is not to get involved in how the stages are designed, but in whether the quality is there and what kind of treatment is necessary Is static firing necessary? Should stages be tested as stages at Mississippi? Should we test it as a whole vehicle with a static firing of the first stage? Should we monitor the vehicles during the shipping to Cape Canaveral?

"What we want to end up with is checkout information at the end of the assembly line, in Mississippi and at Cape Canaveral, digitized in the same form so we can see what went wrong We are measuring so many things that we must have common data processing for each stage and all elements of the spacecraft

"We will have GE working under the direction of Marshall on stages Houston on the spacecraft, and Sloan for the over-all data process We will bring together the checkout information at the end as well as a process through manufacturing, launch, monitoring of parts in orbit so we can make the decision on whether to go on to the moon, and on how parts check out on the moon"

Seamans explained GE's role more formally in a recent speech at Cleveland, Ohio, saying it included these three work areas

- **Integration analysis** of the Apollo space vehicle, including interface and integration requirements of the spacecraft with the launch vehicle and of the space vehicle with the launch control center
- **"Practical methods** for continuous assessment of the over-all reliability encompassing the space vehicle, the ground equipment, personnel and operation and checkout procedures including recommended testing data sensing, data processing and analysis procedures required to achieve a given level of confidence in the reliability assessment"
- **Recommend an integrated** Apollo space vehicle checkout plan and fabricate install and operate the overall checkout equipment"

Seamans said he wanted to emphasize that the approach we are following does not in any way relieve our contractors of their responsibility for reliability and quality assurance

The best illustration of the magnitude of the GE job is that Holmes told Congress "To do this within NASA would mean really the forming almost of another center"

In spite of NASA's assurances, congressional questioners still wondered whether GE's job as a kind of "reliability bookkeeper" gave it competitive advantages that other companies did not have

North American Aviation Inc for example, is the contractor for the Apollo spacecraft It will build the command module, be responsible for the service module, and—according to its original own work statement—be responsible for integration of the spacecraft and its subsystems It also may have responsibility for integration of the Apollo guidance and control system and for integration of the other two modules with the lunar landing module, the construction of which NASA will contract for separately

Boeing, which will build the first

stage for the advanced Saturn C-5 vehicle, may integrate the total C-5 vehicle which includes stages built by North American and Douglas Aircraft Co. This still would leave open the task of integrating the overall launch vehicle with the spacecraft, and it is not yet clear how GE's role of integration monitoring fits with these other contractor assignments.

As to the building of new checkout equipment, Apollo contracts already call for the stage or spacecraft component builder to build some of his own. GE apparently will develop only hardware not already covered by ground support equipment requirements of existing contracts, and even some of this may be procured through an industry competition, according to recent NASA testimony.

Holmes explained to the House subcommittee that there now is a variety of checkout equipment at Cape Canaveral, some of which is not compatible.

"The ideal thing, we think, through this group of Sloan's, is to have a contractor [GE] working with these other contractors through and with our centers so when these checkout equipments are developed they can all fit together and be programmed and called upon by one general digital equipment at a common assembly building at Cape Canaveral to do the over-all comprehensive checkout without starting with all new equipment."

Launch Function Status

This does not mean that GE—or any other contractor—will serve as launch director for flights, Holmes told AVIATION WEEK. "The launch function will remain with the Launch Operations Center, headed by Dr. Kurt Debus. Nor does NASA now plan to hire contractors for any major management task similar to those assigned to GE and AT&T.

The NASA systems office with which AT&T is to work will have about 75 professional people and some 25 supporting personnel. Holmes explained that NASA was attempting to hire "people with wisdom" because success would depend to a great degree on the quality of their early analyses.

"We are trying to hire . . . very experienced systems engineers," Holmes said. "Many—in fact, most of these are at the doctorate level and have had experience in all sorts of weapons—it isn't possible at government salaries to hire these people other than what we have as excepted positions and, as you know, there are limited numbers of these."

To make up for the deficiency in numbers resulting from the salary limitation, NASA decided "you must go to the contractor who has competence in systems management, considerable competence in the management of technical people," Holmes said.

"We felt the Bell Telephone Laboratories was exceptional in this area, certainly, supported by other parts of AT&T." Since most contractors would not like to have such manpower consumed without a resulting chance at production, "we wanted some kind of contractor somewhat unique and not competing in the hardware field of spacecraft and boosters," Holmes said.

Provided that it was exclusively to support Mr. Shea in the manned space flight areas, and it would not be in any of the areas in communication such as satellite communication [that] NASA does and which AT&T is interested in.

We could make this arrangement only on that basis."

Seamans said the idea was discussed in detail with the Defense Department and that NASA Administrator James E. Webb and Defense Secretary Robert S. McNamara "jointly . . . asked the AT&T to come down and discuss this matter with us in the national interest."

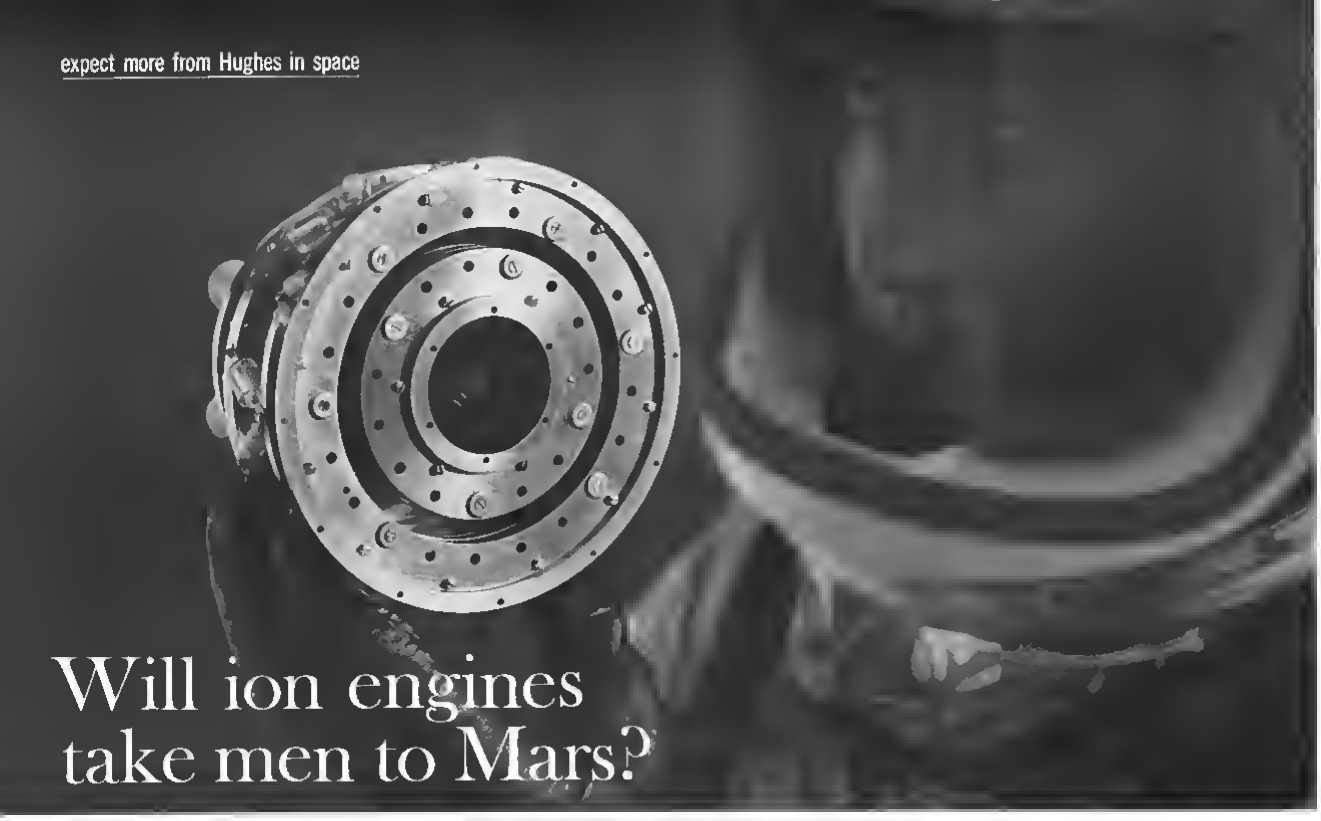
Profit for the two management assistance contracts is being negotiated and will be reviewed annually on the basis of performance in the previous year, Seamans said. The fee being negotiated—which are not necessarily all profit because the government audit may disallow some expenses charged to indirect costs—is between 6% and 7%, but closer to 6%, according to Administration Director Siepert.

AT&T's organization for the NASA project is expected to total 200 technical personnel and also 200 support personnel.

In addition to the GE contract, which probably will total more than $250 million, and the AT&T contract, to which no figure has yet been attached, NASA has in recent months negotiated a $300 million contract with Boeing for the C-5 first stages, a $200-million contract with North American for C-5 second stages, a contract with

RCA Relay Satellite Prototype Shown

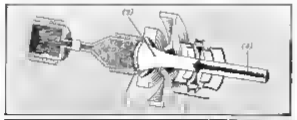
Prototype of the Radio Corp. of America Relay satellite is shown to Senate Committee on Aeronautics and Space Sciences by Dr. Elmer W. Engstrom, RCA president. Satellite has side panel removed to allow a view of the interior. It will be launched this summer to test communications relay feasibility.

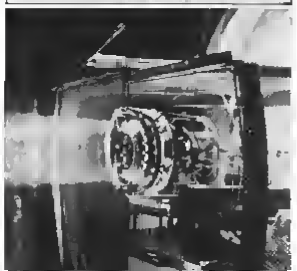


Will ion engines take men to Mars?

This tiny Hughes ion engine produces much less than 1/100 of a pound of thrust. Yet this prototype will lead to larger engines which may be the practical solution to the problem of transporting men to distant planets.

An ion engine is actually an *electrical* propulsion engine. Instead of burning chemicals the ion engine develops thrust by expelling ionized particles. In "weightless" space the constant "push" of only three or four pounds of thrust produced by a cluster of ion engines could propel a vehicle weighing more than 50 tons on interplanetary trips. Eventually, ion engines could send a manned spacecraft to Mars at a speed of two million miles a day. Trips to Pluto, the farthest planet, 3½ billion miles away, may be practical only with this type of engine.





The new Hughes ion engine (1) converts cesium atoms into ions—charged particles. (2) These ions form a beam which is put through a system of electrodes where voltage is applied accelerating the ions to a high velocity. (3) The charged ions are then neutralized to prevent them from being attracted to the space vehicle. (4) Finally the beam emerges at a high velocity—producing thrust.

This ion engine is under actual test in a special vacuum chamber designed for space environment simulation. It demonstrates the principle described as the "ultimate" in propulsion devices.

NASA will test a Hughes ion engine in space late this year. A number of such flight tests will be essential before the complete ion propulsion system, including a nuclear-electric power supply, can be tested in 1965.

Hughes scientists, with company support and under contract to NASA, already have made important gains—in developing more precise control of ions, in methods for increasing engine life, and in devising unique methods of neutralizing the charge of the expelled ions.

Expect more from Hughes. Imaginative pioneering at Hughes is speeding man's progress in a host of new ways—with the SYNCOM communications satellite, with the SURVEYOR moon vehicle, with 3-dimensional radar systems. Today, Hughes is one of the world's most important producers of space age systems and products.

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

North American for the three-man Apollo spacecraft, a contract with McDonnell for the two-man Gemini spacecraft, and has begun work on the manufacturing plant at Michoud, La., the test facilities at Pearl River, Miss., the spacecraft center at Houston, Tex., and expansion of the Florida assembly and launch complex.

All this contracting activity has raised congressional interest in space dollars to a peak. As Rep. James Fulton (R., Pa.) told Seamans in recent questioning, "You have local congressmen saying, 'We are doing a little paying and everybody else is getting the gravy.'"

Questioning in recent hearings on NASA's contractor selection process began when Rep. Fulton asked if NASA considered "any factor of the depressed areas in the U. S. where there is chronically unemployment."

Seamans replied that the factor was considered in any procurement, but said: "Our prime responsibility is to get on with the space program and only in cases where there will be no essential difference in the conduct of a particular contract would the decision be made in favor of a particular depressed area."

Rep. Fulton complained that some of the contracts are too much concentrated," and said:

"We need an even-handed distribution over the country, including programs training scientists, engineers, research work, radio, radar and electrical technicians, from many of our cities and industrial areas. Would you tell us whether you are adopting the plan to have a disbursion of contracts and facilities over the whole United States?"

"In that connection, I might point out Pennsylvania with almost 11 million people in it and paying a good 10%, plus, of the income tax federal taxes of this country, has zero NASA employees in it—not one."

Seamans pointed out that with only about 10 centers, NASA obviously couldn't have employes located in every state. Rep. Fulton agreed, but said: "I feel that the facilities should have a broader spread over the country. Attention should be given so an even flow of benefits go through the states."

Seamans cited the need for waterways for shipping large space vehicles, the use of idle plant space in Michoud, the test facility at Pearl River "in an area in Mississippi where there is room for tremendous economic growth," and the center at Houston "in an area that has the climate for the kind of work that needs to be carried out in connection with the research and development of these capsules." He said other areas "may well be important areas in the future, but said this must be reviewed" on the basis of what the program requirements are.

"You can see there would be some criticism," Rep. Fulton said, "when over 60% of the contracts, research and development, go to three states in this program with all the rest of the states paying the taxes and secondly, it looks to me as if a lot of these cities, these scientists like a good vacation and climate and maybe some of your decisions are being made to give vacations for scientists while they work, rather than on the basis of research and development."

Seamans quickly denied that vacation land climate entered into decisions, and pointed out that Rep. Fulton was citing prime contracts—whereas NASA's "many, many thousands of subcontractors were well distributed through the country."

Rep. Fulton said that "some of us want a clear chance at [this program] for the whole country because we feel it is so big. These areas that have been overlooked by NASA to date, I think, should be looked into and a broader spread of the program reached, because unless it is, you are going to lose the overall support of the country for these programs."

Rep. Richard L. Roudebush (R., Ind.) inquired about NASA contracts in Indiana, saying he wasn't aware of any, and he would be less than frank if he didn't say he was interested in utilization of Indiana industry.

Subcontracting Requirements

NASA witnesses explained that each prime contractor is required to submit plans on how subcontracting will be handled, but that NASA imposed no geographical requirements—only a requirement of seeing that he really gets competition."

They also pointed out that Indiana had 12 direct contracts totaling $1.54 million in Fiscal 1961. This did not include subcontractors or vendors.

Shortly after this, Rep. Fulton came in. Rep. Roudebush said:

"On Indiana, for our friend, say if Indiana was treated as one of the 50 states, it would then get 2% of the program of 100%, and when we look at $1,784 billion for the program for the current year, taken 90% of that contract, you get about $1.6 billion, so that in the end that is at its 2% level, Indiana would get $32 million," Rep. Fulton said.

"As a matter of fact it's only getting $1 million, so maybe you aren't being treated as well as you think you are in your programs."

"I'm really bringing that up to show that we must be able to demonstrate through NASA that there is a spread of the contracting throughout the country and that favoritism is not being practiced because if you haven't heard about it, why it's on the floor of the House already."

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First Details Revealed on Centaur RL10

By David A. Anderton

West Palm Beach, Fla.—Pratt & Whitney Aircraft RL10A-1 liquid hydrogen rocket engine, developed as the upper-stage powerplant for the NASA Centaur space vehicle, has been showing high reliabilities over a large number of test firings under simulated space conditions.

Current values, based on test data from more than 1,000 firings of complete powerplants, show a "functional reliability" of 0.993. A point estimate of reliability, based on a 100-run moving average where all of the run meets all of the test requirements, is at the slightly lower level of 0.989.

The company attributes these high values to the fundamental simplicity of the liquid hydrogen engine and to the internal effort at every level from design through fabrication and inspection to testing. Current engines in the program are essentially hand-built development powerplants. Future production which will split the line between the company's main plant in East Hartford, Conn., and its Florida Research and Development Center here, will be geared to high volume output in rocket-engine standards.

As developer of the upper-stage engines for the Centaur, P&WA has been named among those responsible for delays in that program. By its own estimate the company is willing to admit to about seven months slippage due primarily to an ignition problem that was very difficult to trace, isolate and solve. But it points to the overall schedule for the engine development, which took a little more than three years from the time the contract was signed in October, 1958, until the engine passed its Preliminary Flight Rating Tests (PFRT) on Nov. 4, 1961.

Catching Up

The company says that by the end of this year it will have caught up with the most optimistic schedule ever projected for the program. To date, P&WA has delivered 20 engines, with a few of these shipped out before PFRT because NASA wanted them. The two installed in the first Centaur vehicle were shipped to General Dynamics/Astronautics in June, 1961, and were installed in the Centaur upper stage the following month.

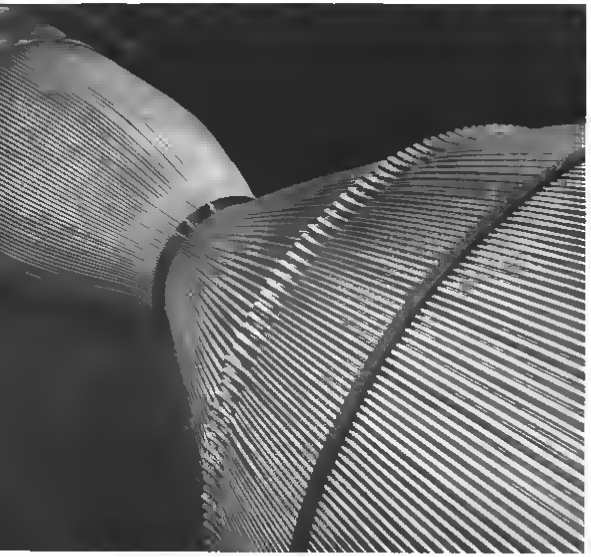
At the end of February, total engine running time during 1,025 firings was approximately 33 hr. (116,837 sec.) which is a great deal of time for a development engine. During that amount of testing, approximately 20 million gal. of liquid hydrogen had been used, of which about one-third went to component development work.

Current high-time engines are close to the two-hour mark.

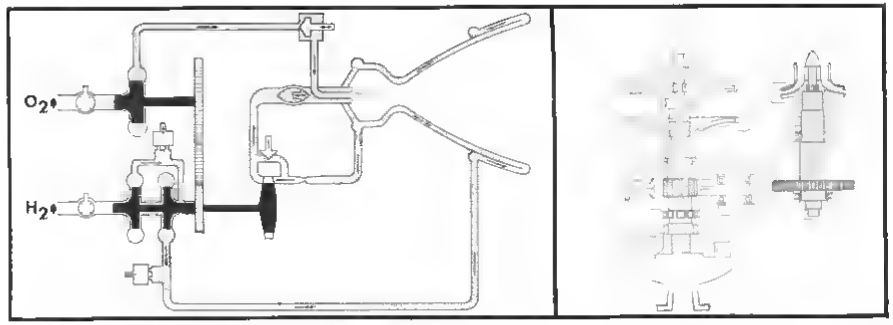
PFRTs, run according to specifications detailed in MIL-E-5419, call for 20 firings over a variety of environmental changes for a total of 2,800 sec. running time over and above acceptance runs. These latter may total perhaps five. The PFRT program is equivalent to about six complete Centaur missions.

Centaur requirements called for two engines, each to be space-rated at 15,000 lb. thrust, with capability of multiple restarts in space after prolonged periods of coasting. Thrust was to be guaranteed within 2%.

The RL10A-1 engine, designed to meet these requirements, carries the 15,000-lb. thrust rating. It delivers a specific impulse which has been called "far greater than any other known rocket engine," and which has a nominal design value of 420 sec. Chamber pressure of the engine is 350 psi., and the expansion ratio across the nozzle is 40:1. This very high ratio gives the engine the appearance of being all nozzle and no chamber.



PRATT & WHITNEY AIRCRAFT RL10A-1 liquid hydrogen rocket engine (right) is of tubular construction, 360 thin-walled stainless steel tubes are formed and assembled (left) to make hydrogen cooled thrust chamber, throat and nozzle walls



SCHEMATIC FLOW DIAGRAM (left) shows hydrogen fuel flow through the turbine to motor cooling passages then through the pump and to the injector. Turbopump assembly cross-section (right) shows details of hydrogen and oxygen flow.

The turbopump system is regenerative: the energy in the expansion of liquid hydrogen to the gaseous state drives the turbine which drives the pumps which pump more hydrogen. The apparent closed circle of this system has led to its being called a "boot strapping."

The turbopump system and a high energy electrical ignition system drawing heavily on the company's J57 turbojet engine experience, give the RL10 engines the capability of space restarts.

The entire engine is gimbal mounted for thrust vector control.

A geometrically similar engine, designated the RL10A-3, is being developed as an upper-stage powerplant for the Saturn. Major difference between the A-1 and A-3 is in burning time. The A-1 will operate for a total of 240 sec., and the A-3 for 470 sec.

There is one other basic difference: the A-1 engines will be built here and the A-3 will come from P&WA's main plant at East Hartford, Conn.

The RL10 engines are unique in one respect: they run cold. Apart from the combustion process, the hottest part of the engine is the turbopump which is running at —100F. In contrast, turbopumps in hydrocarbon fueled systems may run at temperatures near red heat.

This is an advantage in some ways: for example, the turbopump can be made of aluminum instead of an exotic, high temperature alloy. But it is also a disadvantage: new problems arise out of the cold operation of pumps, gear drives, bearings and seals.

Size of the combustion chamber and most components were determined theoretically from parametric data available at the start of design. It remained to choose the expansion ratio which would determine overall length and diameter of the exhaust nozzle.

That ratio was pegged at 40 as the best compromise. Making it less would mean a shorter nozzle and therefore a lighter engine, but at the cost of specific impulse. Making it higher would mean a longer nozzle and therefore a heavier engine, but with an increase in specific impulse.

Layout of the motor follows the standard regeneratively cooled plan in which the hydrogen fuel is used to cool the walls of the combustion chamber. Tubular construction is used to make the walls of the nozzle and throat of the engine.

The decision to use tubular construction—a technique in which the nozzle is formed of a large number of small diameter tubes which carry the coolant flow—for the motor meant careful analysis to obtain a high flow rate, low pressure drop and good cooling. There was enough data to handle the analytical design of such a structure at the time the project reached that point, but there was a lack of more substantial test data.

Length of the nozzle due to its high expansion ratio forced a compromise in the selection of cooling passage length. Ideal length for acceptable flow velocities was greater than one pass through the tubes but less than two passes. Consequently the engineers chose to use a "pass and a half" layout in which the hydrogen enters one set of tubes at a point about one-quarter of the nozzle length away from that throat, flows to the exhaust exit face where it enters a manifold directing it back up along the entire length of the motor through a second set of tubes.

Cooling passages which make up the nozzle and chamber are formed by 360 double-tapered Type 347 stainless steel tubes which have an original wall thickness of 0.011 in. They are formed to varying cross sections and the profile shape of the chamber, throat and nozzle. Then each tube is checked to determine its flow characteristics by measuring flow against the corresponding pressure drop through the tube, and for its dimensions. Each tube is serialized and entered on an IBM punch-card system.

For fabrication, matched sets of these tubes are chosen by the IBM process and these tubes are handled together for fitup and assembly to guarantee that final assembly meets specifications.

Half of the tubes extend the full length of the engine, the other half terminate at the manifold on the nozzle.

The tubes are fitted together and interleaved on a mandrel; thrust chamber tubes, manifolds and bands are added and the whole assembly is prepared for silver brazing. A "birdcage" fixture is used to hold the assembly during makeup and furnace brazing.

Other major component of the rocket thrust chamber assembly is the injector, which uses eight concentric rings of concentric nozzles to inject streams of liquid oxygen surrounded by annular streams of gaseous hydrogen. A rigid mesh screen which covers the face of the injector serves to bleed gaseous hydrogen for local cooling.

Igniter is located in a recess in the center of the injector head. It operates by discharging a high energy electrical spark adjacent to a mix of gaseous hydrogen and oxygen. Most igniter system components were taken from equipment developed for the P&WA J57 turbojet engines. Because two RL10 engines are used in the Centaur stage, a single exciter is mounted in the vehicle to supply the energy simultaneously to the spark plug in each engine. This minimizes any initial difference in thrust which might emanate from non-simultaneous ignition or different transients during the brief buildup to full developed thrust.

The turbopump assembly for the RL10 engine includes an inducer and a two-stage pump for each propellant

component. Head rise is about [illegible] psi per stage, for a pump delivery pressure approximately 1,000 psi.

These pumps, which are part of the powerplant and Pratt & Whitney Aircraft's responsibility, furnish the fuel and oxidizer at pressure to the injector. But because of the peculiarities of the Centaur operation—space starts after weightless coasting—a second set of pumps has been specified in the Centaur vehicle. These pumps, which are called "boost pumps," are considered as part of the stage and tankage system and therefore come under the responsibility of General Dynamics Astronautics.

The characteristic of the boost pumps is the ability to operate at very low inlet pressures with a high volumetric flow rate. Between boost pumps and turbopumps are engine inlet valves which define the boundary between P&WA and GD/A responsibilities.

A two-stage hydrogen expander turbine, delivering 1,000 hp at 30,000 rpm, drives the turbopump assembly. The turbine is a partial-admission type; gaseous hydrogen is admitted over only a portion of its periphery instead of over the entire circumference of the turbine wheel. Because of the low temperature of operation, the turbine can be a dip brazed, aluminum assembly. The pump housings are an aluminum alloy similar to AMS 4281.

Turbopump gears and bearings operate dry, with hydrogen gas cooling. Ball bearings are made with special low friction cages, and hardenable stainless steel is used in the races and balls. Seals are of the carbon face type.

Valve seals are the plastic-lip ball type, some made of Mylar and some of another plastic of the Teflon family.

Flexible plumbing generally used in powerplant buildup to permit some misalignment of parts or dimensional growth during running has been completely eliminated in favor of rigid tubing.

Engine Operation

The engine starts with a cooldown operation, in which liquid hydrogen cycles through its pump and overboard to cool the pump to operating temperature. This takes only a few seconds. The cooldown operation may be eliminated on future engines in favor of a recirculation system, but for the early Centaur flights, cooldown is the chosen method.

The cooldown exit valve closes and the hydrogen then circulates through the pump and to the manifold on the nozzle. The hydrogen continues to pass down to the exit-face manifold, is turned and passes up the tubes toward the motor head. It leaves the cooling structure at the motor head, expands through the turbine and passes to the injector by which time it is completely gaseous hydrogen.

As the hydrogen expands through the turbine, the energy is absorbed by the turbine wheels and converted to shaft power for the pump drives. The cycle accelerates rapidly and the turbines are up to speed in a short time. As they accelerate, ignition takes place at a low combustion chamber pressure.

The engine develops a quasi-steady state condition at about 10% thrust and accelerates from there to full thrust rapidly and smoothly. Thrust control is obtained by a bypass system around the turbine which changes the combustion chamber pressure by controlling the turbopump output.

The engine has the capability of being throttled down for vernier use at cutoff. Engineers emphasize that the RL10 is easily throttled. "Every time we run," one said, "we run throttled."

Because of the low-temperature operation of engine components, P&WA engineers anticipated trouble with pumps, gear drives, bearings and seals. Most of the anticipated troubles never materialized.

Most publicized of the problems that did show was ignition trouble, which caused engines to blow up on starting, and which definitely contributed to program slippage. The original ignition plan was to depend on getting a gaseous mixture around the recessed igniter. But some liquid oxygen flowed back through the screen and accumulated in the head. Under these conditions, sometimes ignition never took place at all. And sometimes it did under other than the desired conditions. This problem was solved about one year ago, says P&WA, and has not been a source of trouble since.

There was another kind of a problem pump stall. It was traced through the pump characteristics to high chamber pressure which was producing a high back pressure on the pump. It was solved by changing the pump characteristics—moving the stall line on its performance map back—with a sweepback of 22 deg on the pump vanes and by a minor modification in the pump control system.

There have been no other problems requiring extensive technical detective work or redesign of parts. There have been some of the usual small problems inherent in any design of a new and complicated system. But none of these have delayed the schedule as much as a day.

All test firings on RL10 engines are made under simulated space conditions. The engine is mounted inside an altitude chamber with a diffuser and a two-stage steam ejector system downstream. The diffuser is sealed with a lightweight door.

During the preliminary starting cycle, the ejectors reduce the test chamber pressure to an extreme altitude condition. At starting, the diffuser door is blown off. There is enough propellant flow at the start to choke the engine throat at the low-pressure level of the tank, so that accurate simulation of a space start is obtained.

During steady state running, the diffuser maintains the pressure necessary to keep full flow conditions in the exit nozzle.

More than 1,000 engine firings had been made by the end of February, 1962. All of them had simulated space conditions for both start and run. Maximum time for any single run so

P&WA Air-Breathing Hydrogen System

Project 304 engine, an air-breathing hydrogen burning system, was the basis on which Advanced Research Projects Agency chose Pratt & Whitney Aircraft to develop the rocket engine then designated LR115 (now RL10).

Ultimate aim of the program was to develop an engine for performance at extreme altitudes. The compressor handled a design mass flow of 550 lb/sec at a low pressure ratio and was driven by an 18-stage turbine. An afterburner was incorporated in the design.

Among the formidable technical problems facing the engineers was the design and construction of a hydrogen flow system that had 4½ mi. of small-diameter tubing and approximately 4,000 vacuum tight joints.

Not much was known about the characteristics of liquid hydrogen then, and what was believed about it was generally cause for pessimism. But P&WA found that hydrogen was safer to handle that it burned better and had better thermodynamics characteristics than they expected.

Project 304 was funded by USAF in 1956. Ohio State University, where pioneering work had been done on gaseous hydrogen rocket engines, was named as a consultant agency on problems. In 1957 the development team and the project moved to the West Palm Beach area to do its first full-scale testing on engine components. The liquid hydrogen pilot plant now on the P&WA premises was built to support that project.

The program was terminated in 1958, and P&WA put many project personnel right to work on studies that were to lead to the LR115 contract.

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In many space age areas, flexible, fast-moving Ryan is making significant contributions. Ryan is the world's largest designer and producer of Doppler navigation systems and jet target drones. Among other Ryan activities are Flex Wing applications, electronics systems for lunar landings, and structures for space vehicles.

At Ryan Aerospace and Ryan Electronics, technical and management capabilities are designed to assure compliance with the most stringent standards.

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA

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fan has been about 12 mm., a time limited only by the available liquid hydrogen

The RL10 traces its history back to the latter half of 1955 and specifically to a group of company-funded studies started then to consider the potential of liquid hydrogen as a fuel. P&WA engineers first studied a single-stage missile using liquid hydrogen fuel, and compared it with a three-stage unit using more conventional rocket propellants. The first study resulted in the conclusion that the hydrogen route was the better one to take.

But they further studied all the reasonable permutations and combinations of pumped and pressurized powerplants, oxygen and fluorine oxidizers, and upper and lower stage propulsion systems. These technical exercises reinforced their initial choice of hydrogen.

Then in 1956 the Air Force gave the company a contract to study and develop a hydrogen-burning turbreathing engine which P&WA designated the 304 engine after the last three numbers on its work orders (see box p. 55).

Parallel effort, once the 304 engine program was under way, continued in the rocket engine, and in 1957 the company made more studies of the system, this time funded from the outside. Following the termination of the 304 engine program in 1958, studies centered on upper stage powerplant designs for the Thor and Atlas boosters. Again running through the range of possibilities, they narrowed down the field to the liquid-hydrogen liquid-oxygen engine, and it was this type of powerplant that was detailed in the first formal proposal of March, 1958.

A negotiated contract between P&WA and Defense Department's Advanced Research Projects Agency was signed in October, 1958. It covered the development and testing of a liquid hydrogen rocket engine designated the LR115, ultimately intended as the upper stage powerplant for a "space truck."

Although much of P&WA's original background work on upper stage designs was done with Lockheed Aircraft Corp., General Dynamics/Astronautics was assigned the job of stage, tank and boost pump design.

Air Force managed the program for ARPA for about one year; the program, by then designated Centaur, was transferred to the new National Aeronautics and Space Administration which assumed the management role.

First firing of a complete engine was performed by P&WA in July, 1959, nine months after the contract was signed. It took little more than two years from that time to qualify the engine. On Nov. 4, 1961, the LR115 engine passed its Preliminary Flight Rating Tests (PFRT), slightly more than three years after the project began.

Soviets Supply More Vostok 2 Data

Washington—Central Aero Club of Russia has supplied Federation Aeronautique Internationale with new information on the Vostok 2 spacecraft and ground equipment which is being translated and will be made public in the U. S. in about a week, according to Martin M. Decker, president of the National Aeronautic Assn. (AW Mar. 26, p. 15).

Decker attended the Federation Aeronautique Internationale Astronautics Committee meeting in Paris where Titov's orbital record claims were certified (AW Mar. 19, p. 29). U.S. representatives agreed to the certification only after Soviet delegates agreed to provide added data. The most significant new information is expected to be the pre-flight plan, location of tracking stations and a radar plot of the flight. Also included is an electrocardiogram of the cosmonaut.

The U.S. position that Titov's flight duration should end when he was catapulted from the capsule also prevailed. USSR wanted the duration to extend until he landed a period of 25 hr. 18 min. The record will stand at 25 hr., 11 min. Titov was ejected from the capsule at an altitude of 21,325 ft., and landed by parachute.

U.S. will attempt to have the pre-flight plan made a required part of the dossier which will be given to FAI after any record flight is completed.

Through its Sporting Aviation Committee, the FAI certified these manned space records:

- Duration of earth orbit—Titov, 25 hr. 11 min.
- Distance traveled in earth orbit—Titov, 436,651.8 mi.
- Greatest altitude reached in earth orbit—Soviet Maj. Yuri Gagarin in Vostok 1, 203.19 mi.
- Greatest mass in earth orbit—Vostok 1, 10,416.84 lb.
- Greatest altitude without earth orbit—Cdr. Alan B. Shepard in Freedom 7, 115,500 ft.
- Greatest mass, without earth orbit—Freedom 7, 4,040 lb.

NAA will claim national orbital records on behalf of Lt. Col. John H. Glenn, Jr. for duration, 4 hr., 56 min.; distance traveled, 131,904 mi., and altitude, 162 mi., as a result of his MA-6 flight in Friendship 7.

NASA Contracts

Recent contracts and research grants of $50,000 or more awarded by the National Aeronautics and Space Administration.

HEADQUARTERS, Washington, D. C.

Lockheed Aircraft Corp., Burbank, Calif.—$201,000 for investigation to develop and design operating procedures to minimize fuel vent fires due to lightning.

Armour Research Foundation, Chicago, Ill.—$93,000 for theoretical and experimental study of radiative properties of simulated Martian and Venusian atmospheres and aerodynamic heating of space vehicles entering these atmospheres.

General Dynamics, San Diego, Calif.—$52,000 for neutron and photoneutron activation analyses of chondritic, achondritic and iron meteorites and terrestrial core drillings to determine rare earth abundances, isotopic ratios and rare earth homogeneities.

Radiation Applications, Inc., Long Island City, N. Y.—$83,000 for research on radiation-induced shape memory in polymers suitable for self-erecting space structures, including considerations of parametric properties and treatment of material and means for achieving restoration temperature in space.

University of Southern California, Los Angeles, Calif.—$104,000 for studies of interactions of vacuum ultraviolet radiation with solid materials.

Florida State University, Tallahassee, Fla.—$784,000 for research in space biology and relevant physical aspects of planetary and space environments.

Cornell University, Ithaca, N. Y.—$66,000 for study of magneto-hydrostatics of magnetosphere of the earth and problems in theory of orbits of space vehicles.

Washington University, St. Louis, Mo.—$67,000 for determination of characteristics of high altitude primary cosmic radiation at low or southern latitudes.

University of Maryland, College Park, Md.—$413,000 for behavioral research and experimental analysis of complex behavioral repertoires under full environmental control.

Yale University, New Haven, Conn.—$98,000 for research on gas chromatographic systems to analyse certain chemical constituents of moon surface.

Johns Hopkins University, Baltimore, Md.—$310,000 for rocket and laboratory experiments and analysis on ultraviolet spectra of upper atmosphere.

University of Illinois, Urbana, Ill.—$310,000 for experimental analysis of micro-neuroanatomy of central nervous system.

Geophysics Corp. of America, Bedford, Mass.—$90,000 for study of meteorology of Mars and Venus.

Vitro Corp. of America, New York, N. Y.—$86,000 for study readiness for nuclear rocket engine maintenance and disassembly building.

Atomic Energy Commission, Germantown, Md.—$951,000 to develop hydrogen turbopump system in support of KIWI B reactor experiments.

AMES RESEARCH CENTER, Moffett Field, Calif.

Electronic Associates, Long Branch, N. J.—$165,000 for services and materials for fabrication and delivery of centrifuge problem computer.

Union Carbide Corp., San Francisco, Calif.—$1,000 for operation and maintenance of helium air separation plant and related systems and equipment for 3.5-ft. hypersonic wind tunnel.

LEWIS RESEARCH CENTER, Cleveland, Ohio

M. B. Associates, Walnut Creek, Calif.—$79,000 for feasibility study to develop hypervelocity gun.

Tinius Olsen Testing Machine Co., Willow Grove, Pa.—$83,000 for testing machine for tension, compression and transverse loading.

A. & D. C. Control Co., Berkeley, Calif.—$51,000 for transformers, switch gear assemblies, motor control centers and current limiting reactor.

USAF Explores Missile Plume Radiation

By Barry Miller

Los Angeles—Air Force is preparing Phase 2 of its Target Radiation Measurement Program (Project Trump).

In this phase, instrumented Nike Javelin solid-propellant rockets fired synchronously with ICBM and IRBM test launchings from Cape Canaveral will observe and measure infrared plume radiation from above the earth's atmosphere during the ballistic missiles' powered and early coast phases.

Efforts also will be made to determine whether missile launches alter the ultraviolet radiative characteristics of the ozone layer of the atmosphere, as predicted. If so, and provided these changes are of sufficient intensity to establish ballistic missile launch signature, the ultraviolet region could offer another means of detecting missile launchings.

The Trump program, alternately designated Project 5043, is expected to obtain varied data on the intensity and distribution of short wavelength electromagnetic radiation emitted by missiles in launch phases and, to a lesser degree, by the atmosphere. This data can then be cranked into many future Air Force satellite programs, which will require as part or all of their missions the detection of ballistic missile firings. Among these programs are the Midas missile alarm satellites, Bambi (Ballistic Missile Boost Intercept) and perhaps Aerospace Surveillance Systems (AW Feb. 19, p. 23).

Trump (AW Jan. 22, p. 28) is an in-house USAF Space Systems Division program for which Aerospace Corp. is providing technical guidance to the Air Force. It is being conducted for SSD by the Air Proving Ground Center (APGC), Eglin AFB, Fla.

Expendable Rockets

For Trump, expendable rockets carrying radiometer payloads will be fired from Venice, on the west coast of Florida, south of St. Petersburg. Passing above the envelope of the earth's atmosphere, they will be able to sense emissions from U.S. research and development ballistic missile launchings much as would a surveillance satellite detecting a ballistic missile attack.

While the Air Force will not reveal the specific bands of wavelengths under study in this unclassified program, they cover wavelengths more varied than those initially assigned to the Midas system, ranging from the near infrared well into the ultraviolet.

The ultraviolet region is attracting USAF attention (AW Apr. 3, p. 33) for a number of possible reasons. Ultraviolet waves above 0.32 microns are not passed by the atmosphere, but may cause perceptible changes in atmospheric emissions, thereby providing basis for launch detection. Ultraviolet detection equipment would not have to be cooled, simplifying satellite or space interceptor-borne detection or homing gear. Highly sensitive photomultiplier tubes are available for these wavelengths.

A detection satellite equipped with both infrared and ultraviolet equipment might then have a dual passive scheme for missile detection. If a potential enemy were to develop booster propellants which reduce infrared radiation during launch, the ultraviolet sensors might be sufficient to establish positive identification.

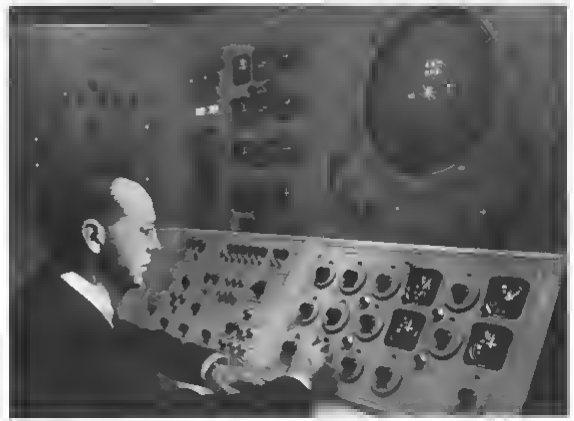
Project Trump is primarily a target radiation program, although ultraviolet atmospheric background measurements will be made from the high-altitude rockets as their trajectories bring them over the atmosphere. Target data will feed into a larger, projected Air Force target and background measurement program.

This information may then provide the basis for determining wavelengths in which maximum signal-to-noise ratio can be expected and will help in selecting optimum wavelengths, given available sensors, natural thermal phenomena, etc., for missile detection systems to monitor.

In-House Effort

Although the program is an in-house effort, some payload or payload equipment will be purchased through competitive selections among industry. A competition for Phase 2 radiometers is anticipated soon, possibly later this month.

The program calls for use of 12 or 18 rocket probes. The first, a Nike Cajun, has already been launched. Both Nike Cajun and Nike Javelin rockets containing necessary radiometers, rocket sensors and telemetry transmitters will see service. Data is to be relayed to ground receivers, reduced and analyzed by Air Proving Ground Center at Eglin. The APGC has extensive capabilities in instrumenting and conducting probes.



F8U-2N Tactics Simulator Delivered to Navy

Goodyear Aircraft Corp. technician checks out control console of a tactics simulator to be used by Chance Vought F8U-2N Crusader fighter pilots at Naval Air Station, Miramar, Calif. Simulator which is connected to conventional instrument flight trainer can display up to eight radar targets simultaneously. Pilot in simulator cockpit interprets displays, flies aircraft into intercept and fires Sidewinder missiles or 20 mm. cannon at the radar blips; then receives rating on mission performance. Tactics trainer incorporates checkout system to detect and isolate electronic subsystem malfunctions.

with high-altitude rockets in reducing data by automatic data processing and in measuring infrared radiation on the basis of its experience with infrared countermeasures testing (AW Sept. 25, p. 322).

Three-Phase Program

Trump will proceed in three phases, the first of which is now well under way.

- **Phase 1 (preliminary experiments)**—This involves developing measuring techniques and making preliminary infrared radiometric measurements utilizing Nike Cajun probe vehicles. For Phase 1, The Te Co., Santa Barbara, Calif., supplied four radiometer payloads designed jointly with Aerospace Corp. The multiple detector radiometers are capable of withstanding high acceleration forces experienced in the solid-fueled rocket launching. They have no moving parts, are sensitive in the near infrared.
- **Phase 2 (infrared and ultraviolet launchings)**—Continuing the program, a series of Nike Javelins will be sent aloft from Venice, Fla., containing various infrared and ultraviolet sensitive payloads.
- **Phase 3 (ultraviolet backgrounds)**—Concurrent with Phase 2, APGC crews will fire a minimum number of Nike Javelin probes with payloads designed to make radiometric measurements of backgrounds in the ultraviolet region. This could prove to be a pioneering background measurement effort for unlike the infrared region there have not been similar ultraviolet background efforts. Similar experiments are contemplated in the Tabstone program (AW July 17, p. 77), now called Hitab, conducted by Naval Ordnance Test Station, China Lake, Calif., for the Navy Bureau of Weapons under funding from Advanced Research Projects Agency.

The Air Force says there is no interrelation between Trump and Tabstone (Target and Background Signal to Noise Evaluation), a similar, at least partially overlapping program. Initial launchings in the Tabstone program were scheduled for early last fall, but the program was late in getting started and only recently the first of 17 instrumented rockets was fired from Wallops Island, Va. Future shots will be handled out of Ft. Churchill, Canada, White Sands, N. M., and other locations. Minneapolis Honeywell is assisting NOTS in the program by fabricating radiometers and telemetry payloads, supplying engineering services.

There is feeling in the industry that fundamental measurement programs of this type conducted from high-altitude rockets and even satellites, specifically in the ultraviolet and some portions of the infrared not related to interests of the Midas program, are long overdue. Some industry sources complain there is too little cooperation among interested agencies, and that at times some agencies are not aware of what others are doing. The Air Force only recently had Aeronutronic Division of Ford Motor Co. conduct a short investigation for it of what was happening in the infrared measurement field.

Programs Accelerated

Both Air Force and ARPA appear to be stepping up these programs, a few let directly with industry. Some programs, like Trump and Hitab, involve securing data from high-altitude rockets, some from aircraft and in one case as low-priority piggyback experiments on actual Midas satellite launchings (AW Mar. 6, 1961, p. 23). A few current target radiation programs include:

- **North American Rocketdyne**—Company is analyzing electromagnetic emission over a wide spectral region from rocket plumes of different propellant combinations. These will be conducted at simulated altitudes up to 100,000 ft.
- **Astrosystems, Inc.**, Livingston, N. J.—This company is conducting an experimental program to determine radiative characteristics of rocket plumes under an Air Force program believed to be funded by ARPA out of funds allocated to Project Defender, the overall program for ballistic missile defense.
- **Lockheed Missiles & Space Co.**—Target-to-background infrared study is being conducted by Lockheed for the Air Force. Aerojet General has a separate radiation measurement program. Both are closely associated with Midas, the former as program manager, the latter as supplier of infrared equipment.

Meanwhile, progress is expected in another program designed to determine the signatures of ballistic missiles on reentry into the earth's atmosphere, rather than at boost. This program, called Press (Pacific Range Electromagnetic Signature Studies) will be in full swing during the forthcoming Pacific Missile Range tests of the Nike Zeus anti-missile missile for which it is intended to supply valuable inputs (AW Apr. 17, 1961, p. 69).

Press measurements will be conducted from ships and aircraft, rather than rockets as Atlas warheads fired from Vandenberg AFB impact in the South Pacific. The Navy at Pt. Mugu, Calif., headquarters of PMR has recently been soliciting proposals from industry for infrared hardware needed in the tests. This includes a short wavelength telescope to be mounted in a Douglas A3D and a two color radiometer.

An earlier procurement by Eglin for an infrared tracking radiometer previously identified as part of this program (AW Jan. 22, p. 28), is being obtained for another Eglin program.

FILTER CENTER

▶**New Integrated Circuit/Semiconductor Company**—Siliconix Inc., has been organized in Sunnyvale Calif. to manufacture and market integrated circuits and other semiconductor products. Organization is jointly financed by Electronic Engineering Co. of California, Santa Ana, and Baldwin Piano Co. Its purpose is both to satisfy internal needs of the two companies for these parts and to seek external markets. Electronic Engineering's annual sales are about $6 million, of which equipment and systems account for 55%, digital circuit modules the remainder.

▶**Companies Explore Teaming**—A dozen small and medium-sized companies with specialized avionics capabilities are jointly bidding on Air Force Planning Study 7990.21 (Aerospace Surveillance) and according to team leader Cubic Corp., will explore future possible arrangements for joint efforts. Teaming not only gives individual outfits a chance to bid on large systems studies and hardware contracts, Cubic officials point out, but it also permits formation of a single task force type group drawing on diverse capabilities that might not be available in a single organization. Companies involved in the Aerospace Surveillance bid are Cubic (systems integration, phase comparison techniques and data handling), Barnes Engineering (optics), United Research Services (radiation detection and ion detection), CEIR (operations and analysis), Computer Systems Sciences, Dunlap & Associates (human factors), Radiation at Stanford (ground radar), Ryan Electronics (ground communications), Sensor (seismology, magnetics and gravitational field studies), Space Electronics Group of Space General (space communications), Straza Industries (display) and Wiley Electronics (aerospace radar and passive radar).

▶**Data Link for JPL**—Microwave data link system, which will connect Jet Propulsion Laboratory's Pasadena, Calif., facilities with the Goldstone tracking facility near Barstow, Calif., will be built by Western Union. Goldstone is a key link in tracking unmanned lunar and interplanetary probes for JPL, which manages NASA's unmanned lunar/interplanetary program.

▶**Jet Stream Detector Ideas Wanted**—Air Force's Electronic Systems Division is seeking companies with ideas for the development of an airborne device capable of detecting the presence of the jet stream.

GE to Coordinate Defense Management

By Philip J. Klass

Washington—General Electric's newly formed Defense Programs Operation, which will integrate customer liaison, field service and resources planning for 17 semi-autonomous departments in GE's Electronic and Flight Systems Group, is patterned after groups that provide similar services for its Electric Utility and Industrial Groups, despite the appearance that it departs from the company's decentralization philosophy.

A major objective of the new Defense Programs Operation, which will have its headquarters in Washington, is to strengthen the company's aerospace and defense business position in the face of increasingly intense competition for major weapon and system contracts (AW Mar. 5, p. 27). GE has slipped from third to fifth position in the list of major defense contractors largely the result of the fall-off in jet engine business.

With the new organization, the company also is adopting a new procedure for bidding on and managing complex system programs involving several departments.

Significance Obscured

The significance of the latest change is obscured by the fact that it results in no major change in the company organization chart, except for the addition of the new Defense Programs Operation (DPO) alongside the Defense Electronics Division, Flight Propulsion Division and Electronic Components Division of the Electronic and Flight Propulsion Group, headed by GE Group Vice President J. S. Parker. Robert J. Brown, who heads the new Defense Programs Operation, has division manager status.

But a number of the new operation's functions in the area of customer field liaison, field service and long-range systems planning formerly were assigned to the operating departments in the three other divisions. These functions are now being centralized in the expectation of important gains in efficiency and operating economies.

The new Defense Programs Operation, unlike the other three divisions, has no manufacturing facilities nor any profit-and-loss operations except for field service and installation engineering.

One of the more important assignments for the operation is to keep abreast of the needs and to anticipate future requirements of GE's defense and aerospace system customers. It also must determine whether these fit GE's capabilities and interests and what resources and operating departments should be used to accomplish these objectives.

Ironically, until about 10 years ago many of these functions were performed by a single centralized organization in GE known as the Aircraft Federal & Marine Division. But when GE launched its company-wide decentralization program in the early post-war years, the objective was to make each operating department a self-contained business with autonomy comparable to that of a separate company.

Centralization Declined

With understandable eagerness to be complete masters of their own destinies, most of the departments operating in the aerospace and defense field created their own customer liaison organizations around the country, and so the centralized group withered.

But where a customer formerly worked with one or perhaps two GE representatives for most of his dealings with the company, the decentralized arrangement might require a customer to deal with a dozen or more representatives, each from a different department.

At a time when smaller companies were striving to create a larger-than-life corporate image of great technical breadth to qualify for major system contracts, GE's decentralization tended to give it a corporate image of a small company with a capability limited to that of the particular department with which the customer was dealing at the moment.

Another problem resulted from the fact that with the new autonomy, departments sought to expand their areas of activity. This frequently led to competition between departments over which should bid on a new job. This was particularly true in the Defense Electronics Division's departments, where the technology changed rapidly and boundaries were difficult to define.

As a result company energies sometimes were dissipated in intense internal struggles, leaving it weakened against external competition. GE officials concede privately.

This kind of difficulty was not unique with GE. Most large companies today face similar problems. But it was particularly acute for GE because of its size, the diversity of its operations and the former emphasis on giving each department autonomy.

These and related problems stemming from decentralization have been under study for several years. Partial solutions have been attempted, sometimes as a pilot operation.

'Space Council'

Several years ago, for example, when the new space market opened, GE organized a Space Business Development Operation, with a 27-man "space council" consisting of representatives of all interested GE departments and operations. When a new business opportunity arose or a request to bid was received, it was reviewed by the space council and interested departments could state their cases.

The Space Business Development Operation would then make a recommendation as to whether the company should seek the business and which department should bid. Over a period of several years approximately 300 such recommendations were made. Only two were appealed by department managers, Brown told AVIATION WEEK. Neither recommendation was overruled.

The success of this approach in the space field recommended its use for all of GE's defense and aerospace activities, and this has been done with the function being assigned to the new Defense Programs Operation.

In 1959 GE attempted to provide a single point of contact in customer liaison for all of its aerospace and defense products by setting up a Defense Field Operations Department in which a single individual in each of five regional offices was defense representative, regardless of the customer or his product interest. Additionally, these regional representatives had some of the same

ROBERT J. BROWN

long-range planning missions now assigned to the new operation but they were not given corresponding authority at that time

The new Defense Programs Operation has now taken over the marketing liaison staffs throughout the country which formerly were part of the individual operating departments These field forces now are organized in six regions, with headquarters in Boston, Washington, Huntsville, Ala., Dayton, Oklahoma City and Los Angeles Each is headed by a regional manager who reports directly to Brown

Where each of the operating departments within Defense Electronics Division, for example, formerly maintained a separate field force in Washington and in most of the other regions, these now will be pooled

The same is true with the Electronic Components and Flight Propulsion Divisions

GE officials concede that under the old arrangement, 'Parkinson's Law' set in, and they expect significant operating economies under the new set-up Equally important, a customer will not find himself answering the same questions about future plans and programs posed by different groups of GE visitors

Resources Planning

Another major mission of the new Defense Programs Operation is one that has not been performed across the full spectrum of GE's defense and aerospace efforts before, but has been handled on a fragmented basis by individual departments This is the task of determining and analyzing future military and space requirements to decide which can make the best use of GE's diverse capabilities and which will be of maximum benefit to the over-all company in the long run Under the previous decentralized operations, there was a tendency for each department to make such decisions largely on the basis of its limited interests

This function will be performed by the Defense Resources Planning Operation of Brown's office It will be responsible for keeping abreast of technology, both within and outside the company This will involve monitoring the business plans and technological development of 17 departments in the Electronic and Flight Systems Group as well as other departments in GE which participate less fully in the aerospace and defense business

This planning group will try to uncover unwarranted duplication of effort among departments and to resolve such controversies Where two or more departments want to bid for a particular job, Brown's organization will study the merits of the situation and make a recommendation which will be binding unless it is appealed and then overruled by Group Vice President Parker

The resources planning group also will seek out new areas where GE needs to devote its manpower or resources

For large, complex weapon and space system programs, where many GE departments and outside subcontractors may be heavily involved, the new organization will include a Systems Management Operation, an innovation for the company The concept was first tried for GE's bid on the Apollo program, and will be used by Brown's organization when GE bids in the mobile medium-range ballistic missile competition (AW Mar 26, p 16)

Temporary Office

To handle the initial proposal effort, a temporary systems project office will be created, with personnel drawn from each participating department The office for any particular program will be geographically situated at or near the facility of the department that is expected to make the heaviest contribution

If GE wins the competition, the project office will be expanded, with the project office manager reporting directly to Brown If the company does not get the job, the personnel will return to their original departments

The management services which the Defense Program Operation provides in such programs will be allocated as an overhead item to the operating departments involved, and the operation will not take a profit on its function This will avoid profit pyramiding within the company and allow each department to receive its normal profit margins

Headquarters Marketing

A fourth major function of the new organization is the Aerospace and Defense Marketing Operation, to be located at the organization's headquarters here under Charles Ruling This headquarters function will include an advanced conceptual type of systems engineering for systems that involve several operating departments but are not large enough to justify creation of a project office This group will be headed by George Prestwich

The organization's headquarters will allocate the respective contributions of the departments involved and mastermind the proposal effort

Another function assigned to this operation will be to provide marketing guidance and systems engineering for operating departments outside the Electronic and Flight Systems Group which produce products for the aerospace and defense market

For example, the controls for GE's aircraft power generation systems are built by company's Specialty Control Departments, while the generators are built by the Direct Current Motor &

Pratt & Whitney Tests JTF10A-20 on B-45

Pratt & Whitney tests its JTF10A-20 turbofan engine on a North American B-45 testbed over the Hartford Conn. area. The JTF10A-20, mounted in belly pod, has been selected as powerplant for the Air Force-Navy F-111A tactical fighter, formerly designated TFX (AW Mar. 26, p. 25). Pratt & Whitney Aircraft Division of United Aircraft designation for the engine is TF-30. Cross-section and dimensional details of three versions of P&WA JTF10A turbojet were published by French engine firm SNECMA, a P&WA licensee. Engine is 38 in. diameter, 128.4 in. long in basic version (AW May 13, 1961, p. 193). Three outline drawings show basic engine (top), engine with duct burning (middle) and engine with duct burning and afterburning (bottom).

Generator Dept., neither of which is part of the Electronic and Flight Systems Group. These elements of an aircraft power system must be integrated into a system suitable for the particular application, a function which will be performed by a group headed by John Woods under Ruling in addition to marketing such systems.

General Electric's aircraft instrument section is another example of a component unit outside the Electronic and Flight Systems Group which will utilize Brown's field organization to market its products and as a source of guidance for aerospace market trends.

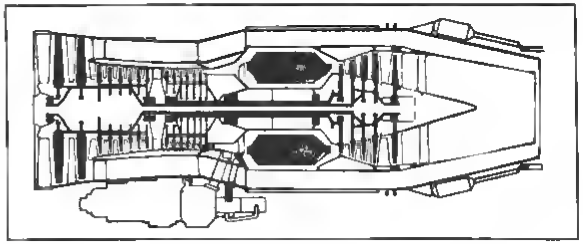
Centralized Intelligence

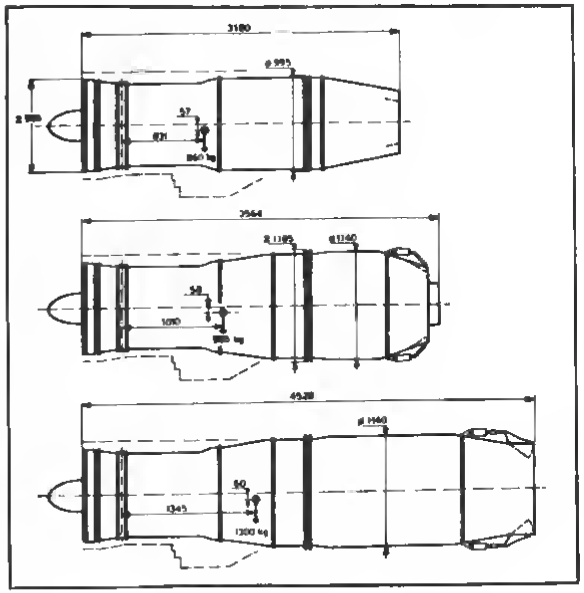
One of the most vital functions of a field liaison organization is to provide intelligence on customer thinking and future plans. In the past this largely has been a decentralized function of individual departments but now it will be handled by a Market Information and Communication Operation at Defense Programs Operation headquarters here.

The function of this group, headed by L. H. Cohen, will be to collect information from all GE sources and devise a communication system to transmit it daily to departments in the Electronic and Flight Systems Group and interested departments outside the group.

Contract and negotiation procedures also will be standardized and centralized in Washington under the Contract Practices Operation, headed by J. C. Wheeler. All public information and advertising for the Electronic and Flight Systems group also will be centralized here, under Louis Naum.

A fifth major operation under Defense Programs Operation is the Installation and Service Engineering Department, the only profit-and-loss function under its cognizance. This department provides installation and service engi-





GE Departments

Operating departments within General Electric's Electronic and Flight Systems Group whose field customer liaison and marketing functions are being centralized in the new Defense Programs Operation include:

Defense Electronics Division:
- Defense Systems Department, Syracuse, N. Y.
- Light Military Electronics Department, Utica, N. Y.
- Heavy Military Electronics Department, Syracuse, N. Y.
- Ordnance Department, Pittsfield, Mass.
- Missile and Space Vehicle Department, Philadelphia, Pa.
- Communication Products Department, Lynchburg, Va.
- Technical Products Operation, Syracuse, N. Y.
- Electronics Laboratory, Syracuse, N. Y.

Electric Components Division:
- Cathode Ray Tube Department, Syracuse, N. Y.
- Power Tube Department, Schenectady, N. Y.
- Receiving Tube Department, Owensboro, Ky.
- Rectifier Components Department, Auburn, N. Y.
- Semiconductor Products Department, Syracuse, N. Y.

Flight Propulsion Division:
- Flight Propulsion Laboratory, Evendale, Ohio.
- Large Jet Engine Department, Evendale, Ohio.
- Small Aircraft Engine Department, Lynn, Mass.
- Aircraft Accessory Turbine Department, Lynn, Mass.

neers to defense and aerospace customers around the world, operates GE's flight test laboratory in Schenectady, N. Y., and operates field service shops for the overhaul of certain company-built equipment. The question of whether the company's jet engine service shops, some of which are located in facilities used for overhaul of industrial products, will be transferred to Brown's organization has not yet been decided.

The sixth major operation under Brown, called International Market Development, under Raymond Smith, will handle foreign sales and international licensing of GE's defense and aerospace products. Headquarters may be in Washington or in Paris.

Because of the diversity and scope of GE's defense and aerospace operations, the organization of these activities has always proved more difficult than for the company's other lines of endeavor in the consumer and industrial fields.

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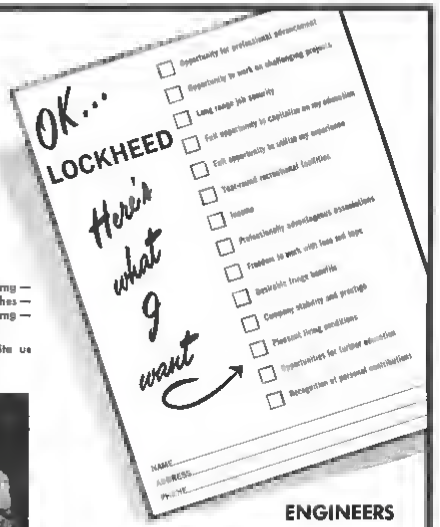

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Franklin Engines Again Entering Market

By David A. Brown

New York—New management, starting with manufacturing facilities, engineering talent and an established company name but virtually no order backlog, is aiming at reinstating Franklin Engine Co. to its former position as one of the nation's largest light aircraft and helicopter engine manufacturers.

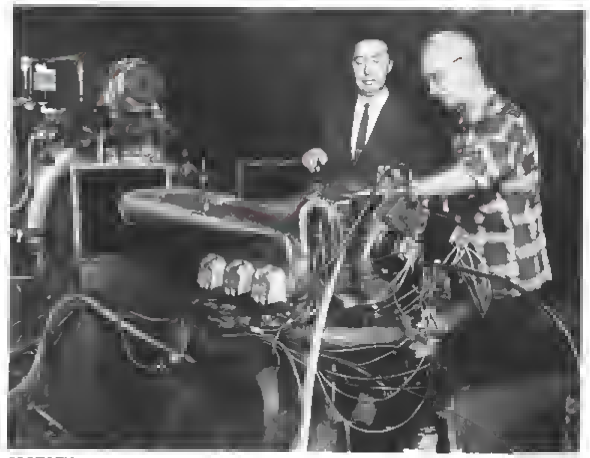
Formerly Aircooled Motors Inc., Syracuse, N. Y., before it shut down completely in early 1961, Franklin now is a subsidiary of Aero Industries Inc. of Bovertown, Pa. Alexandre Berger is president of both companies.

In the eight months since Aero Industries purchased Franklin from the defunct Tucker Corp., an automobile manufacturing firm, the Franklin factory has been rearranged, a new line of six engines has been placed in development and production of a seventh engine currently is under way in limited quantities.

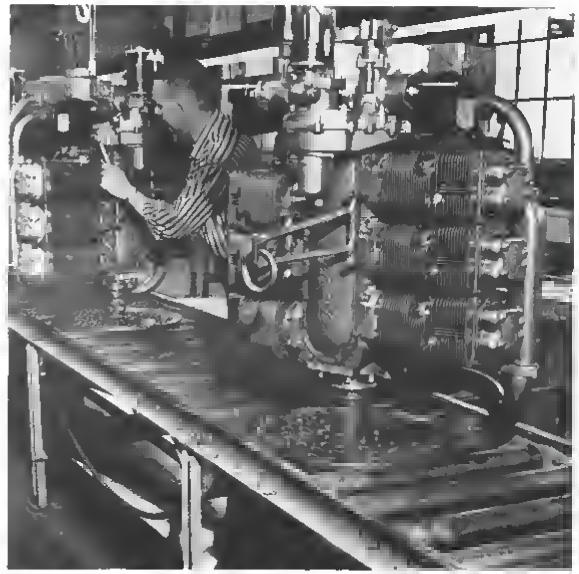
Franklin's hopes are based on receiving substantial orders for its new line of engines in the near future. Berger is confident Franklin can produce engines more cheaply than its competitors even though it will not initially be producing them in the quantities that other light piston engine manufacturers will.

The new line consists of:

- **Two-cylinder** 60-hp. engine, with vertical and horizontal versions designed to power homebuilt and experimental aircraft. Franklin has noted that more than 1,000 of these aircraft are produced in the U. S. each year and that most are powered either with second-hand aircraft engines or with engines designed for other purposes. Berger says response to this engine from amateur aircraft builders has been good.
- **Four-cylinder** engine, delivering 125 hp. horizontally at 2,800 rpm. or 140 hp. vertically at 3,400 rpm. This engine will be the first of the new Franklin line on the market. Certification is scheduled to be completed by July 1, and three airframe manufacturers, including one of the big three, have ordered prototypes for testing. Another major manufacturer is expected to order a prototype shortly. First deliveries were scheduled to be made this week.
- **Six-cylinder** 180-hp. engine with direct drive.
- **Six-cylinder** 200-hp. engine with propeller governor drive.
- **Six-cylinder** 220-hp. engine, geared at 3,400 rpm. with a 7:4 gear ratio.
- **Six-cylinder** 260-hp. engine, geared and turbosupercharged with fuel injection. Engine would deliver rated performance at 3,400 rpm. in either hori-



PROTOTYPE OF ONE of the six-cylinder engines in the new Franklin line shows general configuration of the new family. New engines were designed to have a number of interchangeable parts. Shown left is Alexandre Berger, Franklin president.



STRAIGHT-LINE PRODUCTION is one of the methods being tried at Franklin to cut costs. Approximately 12 Franklin 6VS-335 turbosupercharged helicopter engines are being delivered from this Franklin production line each month.

zontal or vertical position. An alternate version of this engine would deliver 210 hp in a vertical position at 3,200 rpm with direct drive, no supercharger and optional fuel injection.

Already back in production is the older Franklin 6VS-335 240-hp helicopter engine. The engine formerly powered the Bell 47-G3 high-altitude helicopter. Production now is about 12 per month chiefly for conversions of Bell 47-Cs and -G2s to high altitude aircraft.

Berger says the company has no intention of placing into production any of the other engines it formerly produced. They are, he says, out of date compared with the new line. In addition Berger feels that piston engines have only about 10 years' more useful life before the gas turbines begin to take over all aviation uses.

Marketing Aim

Franklin Berger believes, can overcome the stiff competition it faces only by marketing engines of comparable power at both a lower price and lower weight. Berger believes this can be done even though Franklin will not be producing engines in the quantities that other manufacturers will.

Key to low-cost production, Berger feels, is the interchangeability of many of the components of the engines in the new line. Basically, all are the same design with 335 cu in. displacement in the six cylinder models and 225 cu in. displacement in the four cylinder engines.

Cylinder assemblies including pistons will be the same on all engines as will crankshaft segments and portions of the forward shaft housings. The housing will contain propeller governor drive on one engine and gearing for another engine.

Berger, a production engineer himself, has supervised rearrangement of the Franklin factory to provide straight line production from engineering through finished engine. Only about a quarter of the factory is presently in use and of the present employment of approximately 50 persons more than half are administrative and engineering personnel.

Certification of the new engine line is scheduled to be completed within seven to eight months. Primary goal of the company at present is to secure enough orders to begin production of one or more of the engines.

Most of the present production is used, in addition to retrofit of Bell 47-G and -G2 helicopters to high altitude configuration, for replacements to foreign governments, notably Canada and India, who have purchased Bell ships equipped with Franklin engines.

In addition to U. S. airframe manufacturers, negotiations are under way

with at least four European firms including one major helicopter manufacturer.

As late as 1955, Franklin could claim that more than 75% of all helicopters flying were powered by its engines. When the firm closed down, most of the airframe manufacturers hastily redesigned their helicopters for other engines, chiefly Lycoming models.

Now that the factory is again open and spares as well as replacement engines are once again available, Franklin is hopeful that much of the lost market will be regained.

While the top management is new at Franklin, much of the engineering staff has been with the company for a number of years.

Berger, Russian-born and German-educated came to this country in 1940 and was engaged in producing landing gear components for military aircraft during World War 2. In 1950, he became vice president-aircraft engineering for Jacobs Aircraft Engine Co., Pottstown, Pa.

The next year, Berger founded Atlantic Aviation Corp., Bowertown, Pa., a producer of airborne auxiliary power plants and now one of the subsidiaries of Acro Industries.

Franklin Co. is a descendant of the old Franklin automobile company, which perished in the depression of the middle 1930s. A group of engineers who had worked for the company bought the name and patent rights, formed Air-cooled Motors, Inc., and successfully produced and sold engines for light aircraft and, later, helicopters.

Republic Aviation Corp. purchased the company after World War 2 in order to have a source of engines for the Seabee light amphibian. When the Seabee failed to prove successful, Republic sold the engine firm to the Tucker Corp., which planned to use it as a source of air-cooled engines for the Tucker Torpedo automobile.

The Tucker Corp. collapsed before producing any automobiles for sale, and Air-cooled, though financially sound itself, had to operate for a number of years under direction of the court-appointed Tucker Corp. trustees.

Business gradually dwindled as the firm was unable to expand to meet increasing competition and in early 1961 the Tucker trustees closed the plant.

Later that year, Berger incorporated Acro Industries, Inc., as a holding company for the various aviation enterprises he was pulling together and when Air-cooled Motors was placed on the market by the trustees in 1961, Berger bought it.

Subsidiaries of Acro Industries other than Franklin and Atlantic Aviation include:

- **Jacobs Aircraft Engine Co.**, Pottstown, producers of radial aircraft engines. The company has only limited production at present. Federal Aviation Agency says, however, that supplemental type certificates have been issued for three Grumman 164 Ag Cat agricultural aircraft powered by Jacobs R755-A2M engines and that conversion of these certificates into production certificates is a simple process.
- **Feedback Systems Division** of Atlantic Aviation, a producer and developer of missile components and ground support equipment.
- **Energy Transformation Corp.**, which is presently developing a lightweight gas turbine generator.

Net Worth

Sale of approximately $700,000 of common stock in 1960 enabled Acro Industries to increase its net worth from $324,067 at the end of 1959 to $1,103,067 at the end of 1960, last year for which financial figures are currently available.

Berger says 1961 was not a profitable year for Acro Industries, although the loss was small. This chiefly was due to outlays to get Franklin into operation and to continue development work in other subsidiaries.

The company now is breaking even or a little better, and Berger expects that 1962 will prove to be a profitable year.

Aeronautics Teaching In Russia Criticized

Moscow—Russian aircraft designer O. K. Antonov has expressed serious concern over the lack of opportunity and encouragement for student initiative and creativity in Soviet aeronautical engineering colleges.

Antonov said there is danger that students who are now overloaded with formal course work will become "automatons of rote learning." Such students, he declared, have no time to use their imagination and all will be cast from the same mold.

At present, Antonov said, students are not afforded the opportunity to get broad, practical experience by building their own gliders, light airplanes, rockets and small engines in institute shops.

The Soviet college administrators, fearing that the experiments will be failures, hinder them in every way possible, he said.

Antonov urged expansion of college aeronautical workshops and said students should be given more time for dreaming. Only in this way, he said, can the colleges turn out well-rounded engineers rather than mediocre, overly specialized and indifferent people with diplomas.

Thach Delineates ASW Research Needs

By Russell Hawkes

Los Angeles—Industry research in a multi-prong drive to meet seven essential requirements of anti-submarine forces is a prime ASW need, Vice Adm. John S. Thach, commander of the Pacific Fleet ASW forces, said here.

Adm. Thach, speaking before the National Security Industrial Assn., said there is little likelihood of a single decisive breakthrough in ASW techniques to meet the threat of Russian submarines growing because of their improving quality. He said the Soviet Navy standardized its postwar W-class submarine in the Stalin regime and began to produce them in quantity. U.S. naval intelligence experts at one time estimated the Soviets had a goal of 1,200 boats. Apparently the program was truncated to select a more modern design when U.S. progress in nuclear propulsion became evident (AW Mar. 12, p. 74).

Thach said a maximum effort is needed to improve the number, variety and potency of the tools available to ASW commanders and listed these seven important areas of ASW research and development:

• **Detection devices.** These have received the most attention from civilian researchers since World War 2 and performance has improved by perhaps 300% but Thach estimates that the improvement needed was about 900%. He said: "A bargain basement effort won't produce the detection devices we need. Resolute and radical research is vital. Non-sonar methods should be explored on the same scale as sonar." As possible research areas he cited photography, infrared, polar satellite scanning, magnetics, hydrodynamics, human engineering and wake scrutiny.

• **Quick classification.** This is the key to fast reaction. In the past too much reliance has been placed on implicit classification of potential targets by detection sensors. Computers should be adopted for this purpose. Navy would like a device that would indicate a valid submarine contact by something as simple as a telltale light on an operator's console. As a first step, all the sounds of the ocean which can confuse or obscure sonar contacts should be identified and stored in a mechanical memory so that they can be discarded during sonar search for a submarine. It would be desirable to find a distinguishing characteristic in the sound of Soviet submarines."

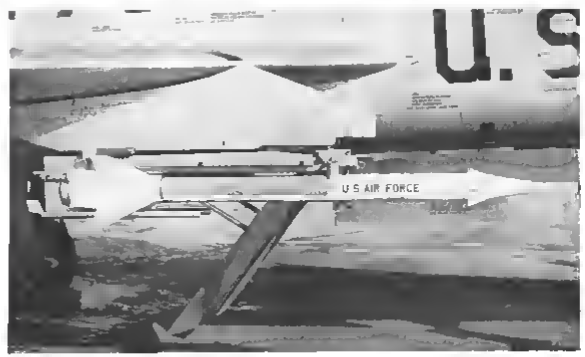
• **Deceptive devices and decoys.** Various types of these are needed to give ASW teams a tactical advantage over submarine commanders. Thach said: "Such devices can confuse the submarine commander. When we can force him to take a look to clarify his tactical situation, he loses one of his most precious possessions—concealment. He becomes vulnerable and more likely to make a mistake, for example, going fast when he should go slow showing his periscope or radar antenna above the surface when he should be deep and quiet or diving deep when he should be pressing his offensive advantage. Industry, intrigued with the shell game approach, is developing a few promising deceptive devices but we need many more."

• **More rapid and reliable communications.** It is important to maintain uninterrupted contact with ASW forces because coordinated action of total ASW capability is a key part of modern tactics. A difficult part of this problem is the establishment of a firm link with our own nuclear submarines operating at deep submergence in enemy-dominated waters. In some parts of the world, killer submarines are the only ASW forces which are secure against air or missile intervention. Communications satellites promise a positive contribution in this area and Navy is known to be developing very low frequency (VLF) radio for communication with submerged submarines, according to Thach.

• **Sustained mobility.** ASW forces must have nuclear-powered surface units to cope with Soviet nuclear-powered missile-carrying submarine. Nuclear power has shifted the tactical balance in favor of the submarine which is now faster, more maneuverable, and has greater range than conventional surface forces. One role of industry must be the development of relatively inexpensive reactors. Thach said superior nuclear power technology is presently the greatest single strategic advantage possessed by the U.S.

• **Greater speed.** A factor in the design of all new ASW systems is the faster operational tempo dictated by Soviet nuclear submarines. Vehicles must move faster, sensors must function at high speed and must have high search rates and the team action of ASW forces must be commanded more rapidly. Ground effect machines and hydrofoil boats may be the prototypes of new generations of destroyers.

• **Versatility.** Navy regards multi-purpose design as an important element in any tactical system. Thach cited need for a triple-purpose missile launcher for use against air, surface, and subsurface targets. He said aircraft carriers are an example of the type of versatility needed. They have roles in nuclear and limited war on the surface and in the air as well as in ASW.



First Photo of USAF Bullpup Training Missile

First photo of Martin TGAM-83, USAF training missile for GAM-83 Bullpup missile shows the five-inch HVAR (High Velocity Aircraft Rocket) used as powerplant and the simplified guidance head from the Bullpup design. Nose section components have been simplified by substitution of model airplane radio control circuits. Aerodynamic performance of the TGAM-83 is the same as the operational missile, but the training round costs one-quarter as much as the weapon version. TGAM-83 originated as a Navy idea and was developed as a concept at Martin-Orlando, but Navy lacked funds to continue the development so USAF picked up the contract. By then, Orlando division was operating with a full work load, so that development of the training missile finally was done at Martin Baltimore. Navy is expected to start buying TGAM-83 after USAF has accepted them for operational training.

AN-13 SAILPLANE features top-mounted turbojet engine.

Russians Claim Glider Speed Mark; New Sailplane Performance Given

Russia has claimed two world speed records for its turbojet-powered An-13 sailplane (AW Dec. 4, p. 23) and has released performance data and specifications on two new experimental sailplanes, the Amur and the MAI-60.

The An-13 flew a three-kilometer course at an average speed of 196 kph. (121.7 mph.) and a 15 kilometer course at 186 kph. (115.5 mph.).

Designed at the O.K. Antonov aircraft factory, the V-tail An-13 has a jet engine weighing 23 kilograms (50.7 lb.) mounted on the fuselage behind the cockpit. The engine has a thrust of 55 kilograms (121.3 lb.) and was built by a design team directed by A. M. Liulka.

The speed records claimed are for jet-powered sports aircraft in the first weight category—up to 500 kilograms (1,102 lb.). Data on the two flights will be sent to the Federation Aeronautique Internationale for certification.

The Amur is a single-place, all-metal, standard-class glider with tapered wing and V-tail. It is essentially a light-weight development of the Antonov An-11 and An-13.

Design Credit

Although built in the Antonov factory, the Amur's distinctive features are credited to a design group headed by V. F. Spivak and A. F. Kolesnikov.

Marked by its simplicity, the Amur costs only half as much to build as the An-11 and An-13. Empty weight has been reduced to 190 kilograms (419 lb.) from 315 kilograms (695 lb.).

Other Amur data include: best gliding ratio 29-30, minimum sinking speed 0.80-0.85 meters/sec., maximum speed 250 kph., towing speed 190 kph., gliding speed at best gliding ratio 90 kph., landing speed 60 kph., maximum aerobatic speed 200 kph., wing span 15 meters (49.2 ft.), length 6 meters (19.7 ft.), flying weight 280 kilograms (617 lb.), wing loading 27 kg./sq. meter, tail surface area 2.18 square meters (23.5 sq. ft.) and wing aspect ratio 21.6.

The MAI-60, now undergoing flight tests, is also a single-place, standard class glider. It has a monocoque, laminar wing, V-tail and single-wheel, semi-retractable landing gear. Construction materials used in the MAI-60 are wood and plastics.

Cockpit is rather small for tall pilots and is admittedly uncomfortable for long flights.

Gliding Ratio

Designed and built by the Student Design Bureau at the Moscow Aviation Institute, the MAI-60 is said to have a high best gliding ratio "close to 40, which is unique for standard class gliders." Estimated sinking speed is "a little over 0.5 meters/sec."

Other specifications for the MAI-60 include: length 5 meters (16.4 ft.), wing span 15 meters (49.2 ft.), height 1.2 meters (3.9 ft.), wing area 10.7 square meters (115 sq. ft.), wing aspect ratio 21, empty weight 210 kilograms (463 lb.) and flying weight 300 kilograms (661 lb.).

PRIVATE LINES

New system of ground instructor ratings has been established by FAA. New ratings are Ground Instructor-Basic, which qualifies the holder to instruct in a basic pilot ground school, Ground Instructor-Advanced, which allows the holder to instruct in a basic or advanced pilot school and Ground Instructor-Instrument, which allows the holder to give ground instruction in an instrument flying school and to operate synthetic instrument flight trainers. The new ratings do not supersede old type ratings, but older ratings may be exchanged for them.

Lockheed Reports 1961 $26-Million Net Profit

Lockheed Aircraft Corp. has reported a 1961 net profit of $26,096,000 following 1960's $42,934,000 deficit that resulted from $110 million in charges on its JetStar and Electra programs.

The company reported additional JetStar development costs and write-downs but the $3,088,000 figure was insignificant beside the 1960 total of $64 million.

Total sales of $1,444,510,000, compared with $1,332,289,000 in 1960, included $361 million in space technology, $372 million in missiles and $650 million in aircraft. The latter included $203 million in F-104 sales to six foreign nations.

Other financial figures recently reported are:

• **Aerojet-General Corp.**, Azusa, Calif., announced record sales and profits during the fiscal year ending Nov. 30, 1961. Sales were $479,402,076, a 13% increase over the previous year's $425,001,397. Net profits were $11,788,040, 17% higher than 1960's $10,097,626. Fixed assets on Nov. 30, 1961, were $78,627,939, an increase of $19,060,639 at the same date in 1960.

• **Beckman Instruments, Inc.**, Fullerton, Calif., reported net earnings of $2,092,913, or $1.37 per share, on sales of $34,550,469 for the last six months of 1961. This compared with $1,586,010 earnings, or $1.15 per share, for the same period in 1960 on sales of $31,423,505.

• **Curtiss-Wright Corp.** earnings dropped to $5,970,561 from $10,031,167 in 1960. Sales for 1961 were $203,487,992 compared with $270,591,689 the year before.

• **General Precision Equipment Corp.** reported profits of $5,866,366, including special credit on sale of property of $545,000, on sales of $234,620,431. The 1960 figures were sales of $244,427,566 and profits of $5,312,692.

• **Lear, Inc.** Profits rose to $4,248,000 in 1961 from the 1960 figure of $3,624,000. Total sales for 1961 were $92,146,000 compared with $90,979,000 the year before.

• **Minneapolis-Honeywell Regulator Co.** reported record sales of $470,205,941 during 1961, topping the previous high of $426,183,310, set in 1960. Net income for 1961 was $24,959,912, or $3.48 per share of common stock, compared with $26,228,148, or $3.74 per share, in 1960. Board Chairman Paul B. Wishart said military and space projects represented 32% of the company's 1961 business.

• **Ryan Aeronautical Co.** showed net earnings of $3,304,645, or $1.89 per share of common stock, during 1961 on sales of $89,448,172. Figures for the previous year were $3,150,000 earnings or $1.68 per share, on $122,711,095 sales. Backlog at the end of 1961 was $81 million compared with $100 million a year earlier.

• **Republic Aviation Corp.** net earnings rose sharply to $10,785,279 on sales of $354,564,878 and were equal to $3.72 a share on 2,897,496 common shares outstanding. Net earnings in 1960 were $4,703,096 on sales of $215,373,844 and were equal to $1.64 a share on 2,862,896 shares outstanding.

• **Thiokol Chemical Corp.** reported 1961 net earnings of $5,325,527, a 49% increase over 1960 earnings of $3,563,302. Net sales for 1961 were $193,865,546, compared with $171,539,729 in sales during the previous year.

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AVIATION WEEK, APRIL 2, 1962

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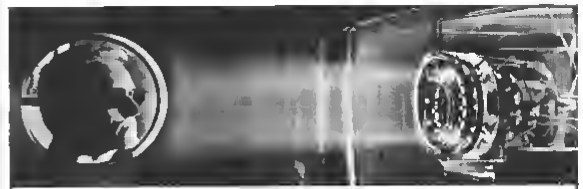

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LETTERS

Space 'Byproducts'

This letter is prompted by Starr J Colby's letter published in your columns Feb 26 (p 114) Mr Colby suggested that AVIATION WEEK subscribers help inform the American public of the commercial byproduct fallout resulting from the space program

I would like to bring to the attention of your readers that the University of Denver Research Institute is currently investigating the commercial byproducts of space research and development under a grant from NASA Our main objective is to identify byproducts now in the non space sector of the economy which originated in whole or in part, from the nation's space and rocket programs For our purposes a byproduct is a device, process, material, system or technique

We would appreciate very much hearing from any AVIATION WEEK readers who have ideas or suggestions on this subject

LLOYD G MARTS
Industrial Economic Division
Denver Research Institute
University of Denver
Denver, Colo

Pilot's Rebuttal

Lest Mr Brown's letter (AW Mar 5, p 102) create the impression among non flying readers that they are not safe aboard airliners which do not carry a flight engineer specialist, or one whose training has been drastically "slashed," I wish to make the following comments

It seems that everyone, including the ATA FAA, air carriers and the ALPA is out to get rid of the 'specialist engineers' All of these, and others, receive verbal lashings from Mr Brown, but none of them receive more blasts than the ALPA As an ALPA member who has been a flight engineer, I wish to assure your non flying readers that we are not, as FEIA policy would have you believe a group that is lacking in understanding, reasoning and ability to control the mechanical operation of the machines we fly

In regard to FE training, I went to FE school for 10 consecutive weeks as opposed to four weeks for copilot training I feel that the training could have been considerably reduced at that time Who cares if there are four six or eight screws holding a motor to a feather pump By definition a FE is to concern himself only with the mechanical operation of the aircraft and is only allowed to change light bulbs and fuses

If he is schooled primarily in the operation of the aircraft, relating it to irregularities and how to correct them then I feel he is carrying out his job as well as a man with a "well worn tool box"

Some readers will recall that the DC-6 was flown the better part of two years in regular service without a flight engineer aboard I do not believe any accident during this period was ever attributed to the lack of a flight engineer or to the pilots' ability to operate the airplane

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters but names of writers will be withheld on request.

At the present time about 80% of my flying is in a CV 340 which does not have a flight engineer Even though the greater number of takeoffs and landings in this type of equipment exposes it to more engine failures hydraulic problems etc, two pilots seem to be able to cope with it mechanically

The record speaks for itself it is the only aircraft in our fleet which has never been involved in a fatal crash after eight years of service

In closing I wish to note that Mr Brown always sneers at the mention of a (three pilot) fail-safe crew In the event that two crew members were incapacitated (the copilot and engineer, or the captain and engineer) the remaining pilot could readily bring even a large jet down to an uneventful landing Now let us incapacitate both pilots and leave the non pilot flight engineer "specialist" the remaining crew member Which airplane would you rather be on?

J P HOUCK
UAL Copilot
Belmont, Calif

Airline Mergers

Everyone interested in the air transport industry seems to have his pet answer to its problems but I have not yet heard a more bold and realistic cure proposed than the American Eastern merger The fact that it preserves competition while relying on consolidation of ground facilities and better fleet utility for its effectiveness is its important point

I would like to suggest a logical extension of this idea for the rest of the trunkline industry First a United National Delta combination would result in an airline essentially the same size as American Eastern with 51 consolidations of ground facilities, and would preserve competition throughout the system

A third logical grouping would be Northwest Western Continental Braniff-Panagra with 41 consolidations of ground facilities It would have a strong domestic service and important foreign routes that should benefit greatly from future supersonic equipment

A TWA-Northeast merger and possibly some North Atlantic carrier affiliation seems to be the only answer to TWA's problems which center around Hughes' control and the North Atlantic competition Let's face it—who would willingly merge into a Hughes-dominated airline?

The total result would be four strong and effective competitors with very little adjustment of routes by CAB necessary The difference in size between the largest and smallest trunkline would be in a ratio of 1 2 or less, versus the present 1 12 ratio

The public would get better schedules more efficient service and lower fares than is possible at present with excessive competition on some routes, uneconomic fleet size and expensive duplication of ground facilities There is no doubt that these mergers could be accomplished without any forced layoff of the industry personnel The growth record and future potential growth preclude any other assumption

The traveling public and the air transport industry deserve nothing less than these considerations

My congratulations to the American Eastern management for their farsighted proposal! May there be more of them and soon

FRANK L ATKINSON
Menlo Park Calif

Engineering Analysis

Regardless of his intent Mr P W Black's letter on the supersonic gap (AW Jan 15 p 126) is a powerful argument for holding sound engineering and economics above attention getting expedience

Even more interesting questions than those raised by Mr Black are Where is the British Comet I now? Is there any airline which is satisfied with its decision to purchase the original turboprop Viscounts?

Wasn't Capital Airlines' demise assured by their decision to go to Viscounts and would not the end have come even faster if they had succeeded in purchasing the Comet 4?

Three major U S corporations have been put to extreme test for errors in management and/or engineering judgment attendant to the problem of producing turbine-powered commercial transports A national government (East Germany) suffered humiliation and heavy financial losses for similar errors Certainly the British have not covered themselves with glory in their efforts at producing commercial turbine powered aircraft Enthusiasm is a wonderful and perhaps necessary ingredient for most significant pursuits but it is a poor substitute for economic and engineering analysis Let's let this baby go full term

Commercial air transport is one of the relatively few areas where we can make a reasonable comparison of performance and service between government and private enterprise The balance certainly appears to favor the private sector Why it ever be so A headlong drive by the United States to be first with a commercial supersonic transport would likely succeed only in weakening or destroying another viable element of the private economy of the world

Understand that I have no criticism of being first in point of time but first in point of quality is surely of far greater importance

ROBERT W CLACK
Assistant Professor
Department of Nuclear Engineering
Kansas State University
Manhattan, Kan

APR. 4 1962

"hot" fastening problems with high temperature Elastic Stop® nuts

ESNA, pioneer producer of self-locking nuts to military specifications, has solved hundreds of specialized problems related to the destructive effects of extreme heat (or cold!) on bolted connections.

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ESNA may be able to suggest a standard production item to solve your high temperature application problem. If no ready-made answer exists, ESNA has the capability—and the interest—to work with you in the creation of a special solution. Call MUrdock 6-6000, Ext. 201, for engineering assistance. For information about standard high temperature Elastic Stop nuts, write Dept. S74-425.

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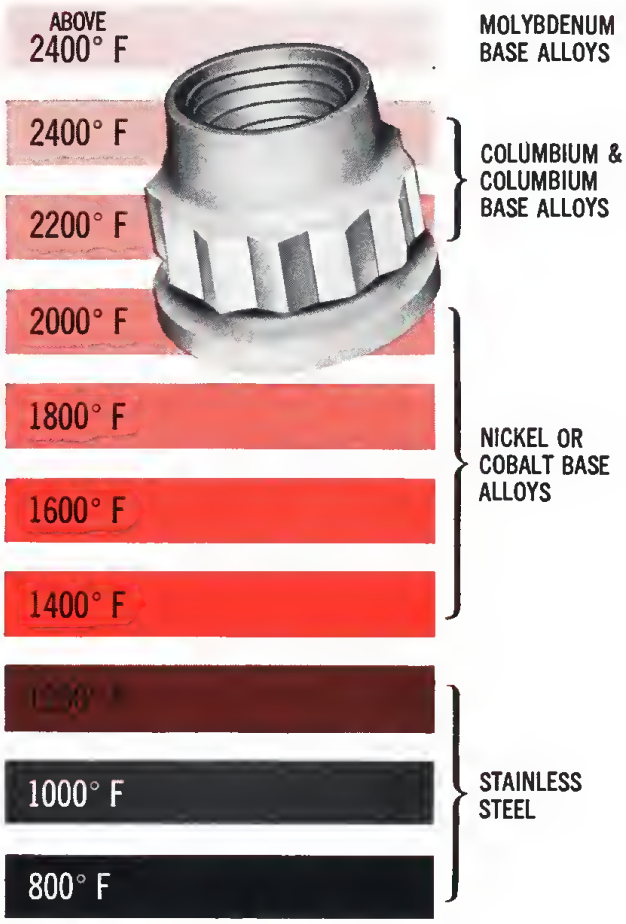
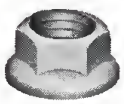
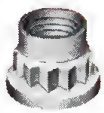


Some practical ESNA solutions



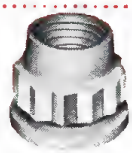
LH3858

Reduced hex, lightweight nuts to develop full tensile strength of bolts of 140 KSI at temperatures —300°F to 900°F. A286 stainless steel, silver plated. Sizes 2—56 through 3/8"-24.



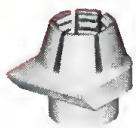
LH3610

Special close-clearance nuts to develop tensile strength of 160 KSI at temperatures to 900°F when used on bolts of same material. AMS-6304 chrome moly vanadium steel, silver plated. Sizes 10—32 through 3/8"-24.



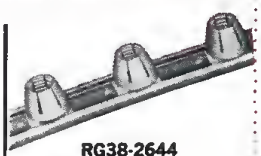
LH4167

High performance nuts to develop full strength (160 KSI) of bolts of same material at temperatures —300°F to 1400°F. Used for reduced times and loads up to 1800°F. Rene 41, silver plated. Sizes 10—32 through 3/8"-24.



Z4361

Shank type nut for turbojet flange sections. Develops full tensile strength of Waspalloy bolts up to 1400°F. Waspalloy PWA686, silver plated. 1/4-28 size, two shank lengths.



RG38-2644

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